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O. P. BRYSCH, Editor

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1. MANAGEMENT

Gas Industry Management

Oil and Gas Transportation in 1959; Here Are the Coming Highlights. *Petrol. Week 7,* 94 (1958) Nov. 14 (6 pp.)

Coming year, while not record breaking, looks promising for U. S. pipeline building. Nation's gas transmission network may gain as much as 6500 miles in 1959, while gas gathering line mileage grows by 2300 miles. For the first time, tanker news in 1959 will have to cover developments not only in transoceanic shipment of crude but also in long-distance overwater movement of natural gas. Most sensational news will come from experimental tanker movements of methane now being carried on by the newly outfitted "Methane Pioneer".

State and Federal Governments Profits from Oil-Gas Leasing. R. D. Lambert. *Independent Petrol. Assoc. Monthly 29,* 20 (1958) No. (2 pp.)

For the government's fiscal year 1957, federal and state governments collected $70,874,734 from oil and gas activities on federal lands in the various states, excluding the outer continental shelf. These activities added another $51.9 million to government coffers in that year alone.

Half Billion Gas Pipeline Outlay Covering 4400 Miles Ok'd by FPC. *Gas Age 122,* 24 (1958) Oct. 30 (6 pp.)

FPC authorization in year which ended June 30 will add 2¼ billion CF to nation's daily gas supply, benefit 132 cities of 50,000 or more population in 24 states. Brief descriptions of about 75 of the 1958 authorizations are given.

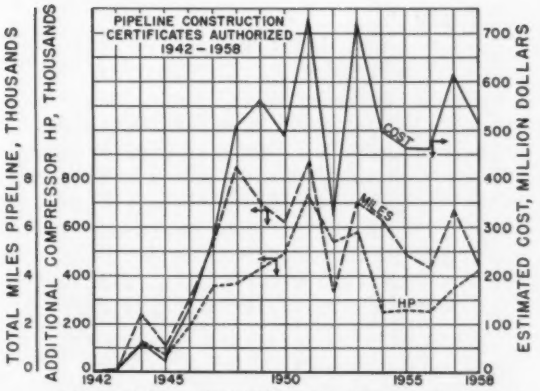
Research

Oil Companies Willing to Spend to Make Money with Research. *Petrol. Week 7,* 56 (1958) Nov. 14 (17 pp.)

More than 50 oil scientists and engineers contributed to special report which covers such topics as squeezing full value from crude, need for a direct oil-finding tool, meters and pumps, justification of oil research and application of research to overcome shortage of manpower.

Pipeline Research 1958. New York: American Gas Association (36 pp.)

Report of activities of the A.G.A.'s Pipeline Research Committee which has fostered research to eliminate current operating problems and to foster new developments to promote more efficient operations in the future. Scope of research is bounded by the well bottom and the city gate. Included in the report are research activities conducted in production and storage, transmission pipeline design and construction, transmission operations and miscellaneous.



(Adapted from *Half Billion Gas Pipeline Outlay . . .*)

Which Project Gets Research Money? O. V. Luke. *Petrol. Refiner 37,* 201 (1958) Nov. (3 pp.)

Successful research hinges on company policy, technical success, economic success, manpower available and balanced research program. Description of how Spencer Chemical evaluates research projects and keeps its program balanced.

Petrochemicals

British-American Goes West, West . . . and Further West. *Can. Chem. Processing 42,* 58 (1958) Nov. (4 pp.)

With completion of the second stage of the Pincher Creek gas processing plant, Alberta has an even greater volume of products suitable to the petrochemical industry as well as others. The B-A plant, which has a hydrocarbon recovery unit as well as two additional sulfur recovery units, now is capable of extracting not only sulfur and condensate but also propane and butane, and of sending natural gas through the pipeline to markets in Eastern Canada. It will constitute the principal single source of gas for the Trans-Canada Pipe Line.

Petrochemicals. Bright Outlook Continues. H. O. Jason. *Petrol. Eng. 30,* C-6 (1958) Nov. (2 pp.)

From an output of 9.2 billion lb, valued at approximately $1 billion in 1945, petrochemical production has risen to a present annual rate of 42.5 billion lb, with a wholesale value of $5.2 billion. This record represents an approximate 12% average annual rate of increase of physical output, compared with a 5% rate for all chemicals and approximately a 3% for the economy as a whole. By 1962, demand may reach 64 billion lb.

Electricity

Capital Needs of Electric Power. F. H. Cook, *Public Util. Fortnightly 62,* 929 (1958) Dec. 4 (15 pp.)

In financing expansion, electric power industry does not make as great use of internal funds as does U.S. industry generally. In 1956, electric power industry used less external funds to produce a dollar of operating revenue than in 1939; relationship of net worth to operating revenue has also been declining—both trends indicate a more efficient use of capital. Small companies tend to use less external funds than do the large. Since 1939, the value of total utility plant behind outstanding capital stock and long-term debt for median purchasing, steam and hydro concern have remained approximately the same. In event of either economic recession or expansion, the purchasing company should produce good earnings, particularly the small enterprise. However, the generating company with unused plant capacity and a heavy industry would fare badly in event of a recession, but profit from an expanding economy.

Aromatics

How . . . and Why . . . Vickers Entered Petrochemicals. J. A. Vickers, Jr. *Petrol. Eng. 30,* C-13 (1958) Nov. (3 pp.)

Progressive Kansas independent just completed a $3.5-million complex for making aromatics. Despite natural advantages which practically assure the Gulf Coast leading the petrochemical race for some years to come, Vickers' 600-mile proximity to the major manufacturing centers of the U.S. was a prime factor in the decision to diversify.

Aromatics—Has Supply Exceeded Demand? R. C. Sweeney. *Petrol. Eng. 30,* C-11 (1958) Nov. (2 pp.)

Answer to question in title was evident during 1958 when price structure of benzene, toluene and xylene dropped considerably. Toluene moved initially from 34 cents to a 29-31 cents/gal range on an f.o.b. basis to an eventual 25 cents/gal delivered basis. Later benzene and xylene moved to lower price levels, averaging about 5 cents/gal under their previous market prices. This was an aftermath of overcapacity and extensive competition for markets which have not grown to meet capacity.

Butadiene

What Next for Butadiene—Can Postwar Growth Be Resumed? C. A. Stokes, L. J. Scofield and W. C. Franklin. *Petrol. Refiner 37,* 166 (1958) Nov. (5 pp.)

If butadiene does not succeed in new chemical uses, it will not be because producers as a whole are lacking in research and market development strength in either the chemical field or in the field of rubber, plastics and polymers in general. It is reasonable to assume that the large diversified chemical companies have recognized that butadiene has taken its place among the basic olefin raw materials as one more petrochemical in perpetually ample supply. Next five to ten years should tell much of the story on new chemical outlets for butadiene.

Competitive Fuels

Coal Arguments Refuted in Midwest Gas Case. *Oil Gas J. 56,* 56 (1958) Nov. 24.

Coal interests laid their case opposing further inroads on their markets in the upper Middle West before the Federal Power Commission, but were unsuccessful in their attempt. While the FPC did not grant any of the applications sought by natural gas companies, it made clear that approval will come eventually despite opposition of competing fuel interests. Those turned down were Midwestern Gas Transmission Co., Northern Natural Gas Co. and Michigan-Wisconsin Pipe Line Co.

Petroleum Development

Economic Factors in Bank Loans on Oil and Gas Production. C. R. Dodson and J. S. McGee. *J. Petrol. Tech. 10,* 27 (1958) Oct. (4 pp.)

Petroleum industry is not independent of or isolated from national economy. Sound loans in oil producing segment require not only a thorough and current knowledge of the industry, but a "feel" for economics as well. Discussion of several important economic considerations.

Public Relations

How Texans Are Educating Editors. J. J. Pareti. *LP-Gas 18,* 57 (1958) Dec. (2 pp.)

LPG dealers in Texas overcame problem of "scare headlines" which falsely blamed LPG for accidents by instituting a "truth" campaign. Program is divided into three steps: 1) informing editors, newsmen and public safety officials about LPG; 2) getting to know local newspapermen and officials that would come in contact with LPG, and 3) conducting investigations of accidents that supposedly involved LPG and ascertaining the true facts in each case.

Wanted . . . Practical Liaison between Utilities and Highway Authorities. A Symposium: **Advantages of Practical Liaison,** E. R. Lockhart; **The Independent Telephone Company Viewpoint,** D. S. Holdridge; **The Standpoint of State Highway Departments,** E. S. Harris, and the **Viewpoint of the U.S. Bureau of Public Roads,** G. M. Williams. *Public Util. Fortnightly 62,* 857 (1958) Nov. 20 (18 pp.)

Exchange of views between spokesmen and representatives of federal and state highway authorities, gas, electric, telephone and water utility companies on the advantages of a practical liaison among highway authorities, utilities and others affected.

Foreign Activities

Czechoslovakian Scientific and Technical Society for Utilization of Fuels. *Rev. Gen. du Gaz 80,* 213 (1958) Sept.-Oct. (6 pp. French text.)

Of the 115 papers presented at the first National Congress of Fuels at Karlovy-Vary (Carlsbad), those of interest to the gas industry are listed by title. These comprise 14 papers on manufacture of coke, 17 on gas manufacture, 8 on gas distribution and 12 on gaseous and liquids fuels. Four-page report on visitors' excursion to the Stalin-Zaluzy synthetic fuels plant at Most is included.

Gas at the 1958 Bruxelles Exposition. M. J. LeJeune. *Rev. Gen. du Gaz 80,* 199 (195) Sept.-Oct. (14 pp. French text.)

General description of the Exposition grounds and the high-, medium- and low-pressure gas distribution systems which supplied gas for the 15 main restaurants and the many special cooking and heating exhibits.

Australia: Oil Activity without Oil. *Petrol. Eng. 30,* B-105 (1958) Dec. (2 pp.)

Despite fact that oil has not yet been found in Australia in commercial quantities, search is being continued. Area of greatest activity is in West Australia where West Australian Petroleum Company is making concentrated efforts by every known method of field activity—including drilling.

Argentine Drilling Starts in 30 Days. *Oil Gas J. 56,* 94 (1958) Dec. 1 (2 pp.)

Target date of January 1 is set by Loffland Brothers Co., Tulsa, Okla., to spud its first development well in Argentine's Comodor Rivadavia area. It will be first of at least 100 wells company will drill for Pan American International (Indiana Standard), which has a $60-million contract with Yacimientos Petroliferos Fiscales, Argentine Government oil agency.

Behind the Bamboo Curtain: An All-Out Drive to Boost Output. *Petrol. Week 7,* 14 (1958) Dec. 5 (3 pp.)

China is counting on almost fantastic increases in production to meet spiraling demands for oil. If announced plans can be taken at face value, Red China is riding crest of a boom in oil development that may exceed its target of self-sufficiency by 1967, last year of the government's third five-year plan.

Cost Accounting

Determining Process Unit Operating Costs. S. Katell and T. J. Joyce, *Cost Eng. 3,* 103 (1958) Oct. (6 pp.)

Unit cost study may be said to consist of three-step analysis: establishment of indirect plant costs, including administrative and overhead costs of total plant as well as cost of general plant facilities; determination of cost of utilities and development of cost of operation for each process unit. In early stages of an experimental program, a unit cost study can determine the advisability of further experimental work on any or all of the process units and, upon commercial realization of the process, it can develop cost data pertaining to operation of individual process units.

Oil Industry Must Take Initiative in Gas Cost Finding, Porter Tells API Meeting. *Gas Age 122,* 14 (1958) No. 27.

It is likely that the FPC will find costs above current market prices, but speaker tells oil meeting that this must not be grounds for justification of "improper or illogical" cost accounting methods. If FPC attempts to fix price of natural gas through a system based on determination of cost of exploration and production, it will face "one of the most complex cost accounting problems ever presented to a regulatory agency."

Education

Only the Skilled Can Work. *Petrol. Eng. 30,* A-25 (1958) Nov. (3 pp.)

Brief review of the American Petroleum Institute's contributions to training of personnel. Program includes four schools of technology, vocational training courses, supervisory development, training in refining, marketing training and area training.

LPG Promotion

Now Is the Time to Sell Weed Burning. H. Crane. *LP-Gas 18,* 39 (1958) Dec. (4 pp.)

Weed burning sales can increase summer load, but approach that will aid in capturing this market should be planned while ground is still frozen. Annual volume consumed for weed burning in the far west alone is 8-10 million gallons.

Secrets of Carburetion Sales. D. Reber, *LP-Gas 18,* 41 (1958) Nov. (4 pp.)

Dealers across the nation are realizing that carburetion sales can mean a substantial increase in gallonage sales. Outline of proven approach to potential market is aimed at developing new business and increasing profits.

Maintenance

A Concept of Maintenance. J. B. Smith, Jr. *Petrol. Eng. 30,* C-7 (1958) Dec. (5 pp.)

Scientific facts and principles must replace rules of thumb and educated guesses now used as basic tools by so many maintenance engineers. Just as cures for ills of men depend on knowledge gained from medical research, which is then applied by physicians, so corrective measures for material failures depend on knowledge stemming from maintenance research, which is then applied by line maintenance engineers. Concept provides what is believed to be a structure of maintenance fully capable of satisfying needs of industry, whether they be for the present or for the future.

2. ENERGY SUPPLY AND ECONOMICS

Petroleum Reserves

United States Petroleum Forecast and Dynamic World Growth in Demands. A. Cadle. *Petrol. Eng. 30,* E-5 (1958) Dec. (3 pp.)

Prediction for U.S. consumption in 1959 is a 4% or better increase, and 11% for the free foreign area. Demands have by no means reached a saturation point in U.S. petroleum industry. Future pattern in underdeveloped areas of the Western and Eastern Hemispheres is one of rather astounding future expansion in use of petroleum. Western Europe shows even greater potentialities, and in that area, as well as balance of Eastern Hemisphere, prospects for distillates and residual fuel oil exceed percentage increases expected for gasoline. These increases in demand translate into a growing need for huge development of crude oil production and for building of transportation, refining and marketing facilities.

Deep Drilling and Extensions May Increase Potential of Nesson Anticline Area. D. D. Dallas. *World Oil 147,* 148 (1958) Dec. (3 pp.)

Within seven years, North Dakota has been transformed from a non-oil state to a 13-million-bb/year producer—mainly because of the Nesson Anticline. Predictions are that area's present 75-mile north-south limits may be extended to 100 miles. Review of Williston basin's outstanding geological structure including present activity, trends, plus a detailed report on drilling and completion programs in the area.

Calculating Recoverable Oil Reserves. D. H. McLendon. *World Oil 147,* 119 (1958) Nov. (6 pp.)

Recoverable oil reserves can be determined by application of nomograph described. Factors involved in class formula are porosity, oil saturation, formation volume factor and recovery factor. Since nomograph goes further, thickness of oil-saturated producing section and surface acres of property being considered for evaluation also are incorporated. No discussion of structural position or secondary recovery is included.

In 5 Years Expect New Cycle for U. S. Oil Discovery. *Oil Gas J. 56,* 112 (1958) Nov. 10 (2 pp.)

New cycle of oil discoveries may start developing in this country within the next five years. Back of this prediction is a movement among oil finders to re-examine old ideas and explore new ones for a fresh approach. Areas to be investigated include New Mexico, the tidelands, the Great basin, Rocky Mountains and Alaska.

Gas Reserves

Look for a Big Gas Play in Alberta. *Petrol Week 7,* 28 (1958) Nov. 14 (4 pp.)

These are the important factors: 1) Tremendous thicknesses in gas-bearing sediments mark the 500-mile foothills belt; 2) export market is biggest factor behind present campaigns to develop new gas reserves in the area; 3) drilling to date has been widely scattered, but discoveries have been impressive, giving rise to estimates of tremendous reserves.

Energy Sources

Natural Gas as Energy and Primary Material for Italian Industry. C. Padovani. *Revista dei Combustibili 12,* 653 (1958) Sept. (31 pp. Italian text.)

Survey of evolution through which Italian gaseous hydrocarbons have reached first rank among power sources and raw materials for synthesis available to Italian industry. Various fields of application: automotive traction, boiler and industrial oven firing, electric power production, household uses and chemical syntheses, are reviewed. Particularly sharp increase in last three fields is emphasized. Chemical exploitation of natural gas, by synthesis based on carbon and hydrogen derivatives, is further treated more in detail, with some mention of primary Italian achievements.

Coal Evaluation

Fundamental Concepts of Incremental Maintenance Costs. D. B. Zelenka and R. H. Travers. *Combustion 30,* 53 (1958) Nov. (4 pp.)

Ohio Edison System, which serves an area of approximately 8900 sq miles in sections of central and northeastern Ohio and western Pennsylvania, has eleven steam electric plants containing generating facilities of various ratings. This variety of equip-

ment and a two-to-one relationship in coal costs along with a widespread transmission system, the authors believe, dictates a careful study of costs of delivered power.

Performance Should Be the Basis or Coal Selection. H. B. Lammers. *Coal-Heat 74,* 7 (1958) Nov. (4 pp.)

Predictions indicate that coal's percentage of the total thermal energy for utility electric production will be 85% of the total by 1975. Just how accurate these forecasts are is yet to be determined and depends on many factors alone that time alone will reconcile. Performance should be the basis for coal selection. Comparative fuel costs should include incremental costs. Having selected the coal with the lowest cost, every effort should be made to secure such fuel for life expectancy of the equipment.

Coal Research

Trends in Present Day Coal Research in the United States of America. A. F. Williams. Part 1. *Coke and Gas 20,* 360 (1958) Sept. (5 pp.); Part 2. *Ibid.,* 426 (1958) Oct. (5 pp.)

Discussion of present day and possible future development in U. S. coal industry and with basic researches being conducted. Some emphasis is placed on coal carbonization, gasification, the Fischer-Tropsch synthesis and hydrogenation. Part 2 deals with current fundamental researches into coal structure and analysis. Also mentioned are main organizations connected with coal research, professional manpower employed and distribution of funds among the various projects.

Thermoelectricity

New Materials Advance Direct Heat-to-Electricity Studies. *Gas Age 122,* 23 (1958) Nov. 27 (2 pp.)

Westinghouse Research Laboratories scientists have discovered a class of materials which can convert heat of gas or any burning fuel, or other high-temperature source of heat, directly into electricity. Such thermoelectric materials produce electricity simply, silently and without any moving parts. Because of the immense potential importance of its practical applications, this method of electric power generation is object of intense scientific research throughout the world.

Thermoelectricity . . . Its Impact upon Science and Technology. C. Zener. *Ind. Sci. and Eng. 5,* 26 (1958) Oct. (6 pp.); *Ind. Laboratories 9,* 30 (1958) Nov. (9 pp.)

Thermoelectricity furnishes an excellent example of interaction of science and technology. Science of physics of solids has led to an extensive development of materials for technological applications. During this development, many scientific questions have been raised, the answering of which has furthered the science of solid state physics. Major role to be played by thermoelectricity: totally new uses for power generation and refrigeration rather than in mere replacement of currently used equipment.

Nuclear Reactors

Heat Transfer in a Cross Flow Nuclear Reactor. C. L. Larson. *Nuclear Sci. and Eng. 4,* 607 (1958) Nov. (16 pp.)

Heat transfer between mutually perpendicular fuel and coolant channels of a nuclear reactor is studied for both isotropic and anisotropic conducting media. By means of an electrical conduction analog, a characteristic length of a unit cell of the reactor is experimentally determined for channels of rectangular and circular cross section. Empirical expressions for this characteristic length are given which closely fit the experimental data. Finite difference calculation is used to determine temperature distribution within a unit cell.

Energy Sources

Thermoelectric Generator. R. W. Fritts and S. Karrer (assigned to Minnesota Mining and Manufacturing Co.) U. S. 2,858,350 (1958) Oct. 21.

Thermocouple-type thermoelectric generator for controlling gas shut-off in case of pilot light failure consists of a stainless steel tube for outer element containing a fiber glass insulated Pb-Te alloy rod as internal element. Latter alloy has greater thermal expansion and upon heating the hot junction end it expands against a spring to make pre-set contact with the cold junction point.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Air Drilling

Combatting Intermediate Quantities of Water in Air/Gas Drilling. B. V. Randall, J. L. Lummus and R. P. Vincent. *Petrol. Eng. 30,* B-26 (1958) Nov. (4 pp.)

Principal deterrent to expanded use of air or gas as a drilling fluid has been problem of controlling influx of water into well bore. This problem may be considered in three parts: 1) small quantities in so-called "weeping" formations; 2) intermediate quantities, and 3) excessive quantities which, from a practical standpoint, generally dictate conversion to conventional mud drilling. However, laboratory and

field tests have proven effectiveness of new foaming agent which permits air and gas drilling with water influx up to 60 bbl/hr.

Stearates Used to Prevent Balling of Moist Cuttings. B. V. Randall, J. L. Lummus and R. P. Vincent. *Drilling 19,* 76 (1958) Oct. (2 pp.)

Addition of zinc or calcium stearates effectively prevents agglomeration of bit cuttings in the presence of water production ranging from trace amounts to approximately two barrels/hour. This procedure requires a solids injector which was developed for this purpose. This device is satisfactory for injecting stearates or other finely ground powders into an air or gas stream against pressures as high as 750 psi. It is further concluded that in addition to their anti-balling properties, stearates effectively reduce friction between drill pipe and the walls of a hole while drilling with air or gas.

Core Testing

Direct Evaluation of Water Sensitivity of Reservoir Rocks. R. T. Johansen and H. N. Dunning, *U. S. Bur. of Mines Rep. of Invest. 5422,* 1958.

Method for direct evaluation of water sensitivity has been developed based on measurement of water-vapor adsorption. Correlation of such data with the results of nitrogen-adsorption measurement provides valuable information on content and properties of clay minerals in sedimentary rocks. Method is relatively simple and has the advantage that it may be used with small, irregularly shaped chips or shale-streaked samples, as well as with typical core samples. Methods previously employed required separating clay from the rest of reservoir-sample material and then performing a clay analysis either by X-ray diffraction, differential thermal analysis, liquid permeability, or a combination of these methods. This water-vapor-adsorption method requires measuring only a few points on the isotherm to tell whether or not the sample is water sensitive. Goal of these measurements is not to determine type or amount of clay present, but what will be its sensitivity to flood water. Method gives a direct means of solving this problem.

Drilling

Bottom Hole Hydraulics Helps Realize Full Potential of Increased Rig Horsepower. R. W. Colebrook. *Drilling 19,* 82 (1958) Oct. (2 pp.); **Downhole Power Speeds Drilling.** R. W. Colebrook. *Oil Gas J. 56,* 172 (1958) Nov. 17 (5 pp.)

Amount of hydraulic power at the bottom of the drill string depends on both the mud system and the down hole device which the mud operates. To get the highest down hole hydraulic power, two conditions must be met: 1) mud system losses must be reduced as much as possible, and 2) down hole device must be matched to the rest of the system.

A Challenge to Operators and Designers of Equipment. H. Pistole and M. E. True. *Drilling 20,* 82 (1958) Nov. (4 p.); **Three Ways to Cheaper Drilling and Production.** H. Pistole and M. True. *Oil Gas J. 56,* 140 (1958) Nov. 10 (4 pp.)

In proper sizing of wells and elimination of unnecessary development ventures may lie answers to many of the problems which confront the industry. Substantial progress has been made in improving drilling and producing operations, but much greater strides must be made in the immediate future if techniques and equipment to produce crude at costs permitting a reasonable return on investment are to be developed.

Chemical Control of H_2S During Drillstem Tests. J. U. Messenger. *World Oil 147,* 111 (1958) Dec. (2 pp.); *Oil Gas J 56,* 64 (1958) Dec. 8.

Chemical control of hydrogen sulfide gas has proved effective in Canadian operations. Ammonium hydroxide is used to protect rig crews from toxic effects of gas.

Comparing the Rotary with Potential Drilling Methods. R. Simon. *J. Petrol. Tech. 10,* 28 (1958) Nov. (3 pp.)

Most new methods of oil well drilling achieve increased rates of penetration essentially by increasing the mechanical power input to the rock over the maximum practical power level obtainable by conventional rotary drilling. However, whether this would decrease the drilling cost per foot of hole depends on other factors as well, such as cost of operation per unit time, well depth and distribution of rocks of various drillabilities at the well site.

Diamond Turbo Bits Do Well in Tests. *Petrol. Week 7,* 36 (1958) Nov. 14 (3 pp.)

Series of turbodrill tests still being conducted by Shell Oil Co. in West Texas, Montana and Alberta indicates that major drawback—center burnout—that made them unsuitable for turbodrill operations has been licked. Tests indicate that newly-designed diamond turbo bits having large spiral waterways give better operational life. New bits may spur turbodrilling efforts in the U. S.

Drilling by Vibration. R. Simon. (Trans. ASME, Paper No. 58-PET-21).

Analysis of vibratory drilling process, based on assumption that load presented by the bit vibrating on the rock to the vibration generator, a magnetostriction transducer, can be represented by a force-dis-

placement characteristic with hysteresis. Conclusions reached are compared with experimental observations on performance of vibratory drilling systems.

Russians Note Improvements of Pipeless Electric Drill. A. J. Steiger. *Drilling 19,* 99 (1958) Oct.

Moscow report states that new model pipeless electrodrill is powered by a 50 instead of a 40 kw electric motor, is run at 2000 rpm instead of 600, and has a specific cutting power of 240 watt/cm^2 which is triple that of old model. It has a smaller drill diameter, operating in 6-in. casing with a 5¾-in. bit instead of the former 9¾ in.

What the French Learned about Turbodrilling at Lacq. C. Menetrier and J. Raynal. *Oil Gas J. 56,* 64 (1958) Nov. 24 (5 pp.)

Two years of turbodrilling experience at Lacq gas field, southwestern France, drawn from drilling more than 90,000 ft of hole, have shown that drilling rate and daily footage can be maintained at a high rate, but bit footage is only 60-80% of that given by rotary tools.

Drilling Mud

Additional Mud Storage at Nominal Cost. J. Cox and R. W. Scott. *World Oil 147,* 105 (1958) Dec. (3 pp.)

Kerr-McGee Oil Industries, Inc., recently installed a unique liquid mud storage facility aboard their Rig No. 46, an offshore drilling barge. A 10-ft diam fender column, an integral portion of the barge structure, was converted to liquid mud storage. An additional 500 barrels of storage was obtained at a nominal cost of $12,000.

New Developments in Gyp Muds. R. J. Smith. *World Oil 147,* 138 (1958) Nov. (3 pp.)

Gypsum muds in the past have not been universally accepted because muds with high gel strength characteristics have prevented their use in areas requiring weighted muds. But with the advent of a new chemical material—ferrochrome lignosulfonate—gypsum muds now are applicable over a greater range of drilling conditions. It is being used extensively for controlling viscosity, gel strengths and filtrate loss in gypsum muds, sea-water muds, lime muds and freshwater muds. Easier maintenance, closer-to-gage holes, fewer fishing and stuck pipe jobs and better resistance to contamination are some advantages.

Viscosity of Clay Suspensions. N. Street. *World Oil 147,* 151 (1958) Dec. (5 pp.)

Natural bentonite, from which drilling muds are made, usually is in the sodium form. When bentonite is made up into a suspension in water, particles are in the extended chain structure because of edge to face flocculation and relatively high 001 face zeta-potential. If natural bentonite were in the calcium form, considerably lower dissociation of calcium (than sodium) bentonite would give a lower zeta-potential. Repulsion between the 001 faces would be less than for the sodium type, the chain would be more coiled and a lower apparent viscosity and yield stress would be apparent.

Exploration

Alaska Drilling Due Big Pickup. *Oil Gas J. 56,* 75 (1958) Dec. 1 (4 pp.)

Leasing is heavy throughout much of the new state, but most drilling during next few years will center around Gulf of Alaska, Kenai Peninsula, Cook Inlet and Betheland Cooper River basins.

Lucero Basin Attracts Wildcatters. S. A. Wengerd. *Oil Gas J. 56,* 207 (1958) Nov. 10 (4 pp.)

With the acquisition of 12,000 acres of Acoma and Laguna leases recently, Ula Mining Corp. revealed its vast acreage-ownership position in the Lucero basin of West Central New Mexico. Company has acquired over 140,000 acres of federal, state, fee and Indian leases surrounding the corner common to Socorro, Valencia and Catron counties. Large 4000-sq mile area resembles in topography and structure the San Juan basin to the north.

In South Texas' Wilco Trend Natural Gas Prospects Are Good. F. L. Oliver. *World Oil 147,* 123 (1958) Dec. (5 pp.)

Wilcox Trend includes 193 fields producing from Wilcox reservoirs. Although area presents geologic and engineering problems, operators can expect better than average success ratios. Ready market and prices paid for gas and condensate make the Trend an interesting area for exploratory drilling.

Fracturing

Hydraulic Fracturing Pays Off. T. M. Garland and W. C. Elliott, Jr. *World Oil 147,* 155 (1958) Nov. (5 pp.)

Studies conducted in North Texas' Strawn prove that hydraulic fracturing results in increased primary recovery, decreased decline rates and high initial productivity, with average production rates increased up to 150%.

Geology

Are All These Dry Holes Necessary? E. M. McKee. *Oil Gas J. 56,* 298 (1958) Nov. 17 (5 pp.)

While no well can be guaranteed to produce oil or gas before being drilled, a large number of the dry holes should never have been put down. Careful and

experienced interpretation of geological data frequently can delineate the productive and nonproductive areas within a structure. This careful and experienced interpretation is, in the author's opinion, being ignored.

New Look at Salt Dome Geology May Increase Gulf Coast Reserves. V. N. Sovinsky. **Part 1. Problems of Detailed Correlation.** *World Oil 147,* 180 (1958) Oct. (2 pp.); **Part 2. Modified Theory of Salt Movement.** *Ibid.,* 111 (1958) Nov. (4 pp.)

In Part 1, author reviews some time-honored geologic concepts, noting limitations of some methods. He further believes that the difference in density between salt and sediments can explain adequately only the movement and existence of salt pinnacles with vertical flanks in the sea of sediments. When study shifts to salt structures having flanks sloping with dips as low as 35 degrees, need to evolve a modified theory involving tectonics is imperative.

Study Reveals Mississippi Series Possibilities. S. B. Anderson. *World Oil 147,* 136 (1958) Dec. (9 pp.)

Facies problems in Upper Madison group are discussed in this study of Madison group of Mississippian age in northwestern North Dakota. Names, definitions, correlations, occurrence, lithology and thickness of Madison group formations are presented. Author points out that porous horizons encountered in Mississippian series may provide excellent oil and gas reservoirs if they meet one or more combinations outlined.

Logging

Electric-Log Interpretation. S. H. Southwick, J. K. Kerver and W. O. Winsauer. *Oil Gas J. 56,* 193 (1958) Nov. 17 (9 pp.)

Authors say a qualitative method of electric log interpretation has been found applicable to both clean and shaly rocks. Method was found to give a good representation of potential and resistivity data on clean and shaly rocks which contain formation waters of high or low salinities. It requires an accurate measurement of the potential, the resistivity of the mud filtrate, the resistivity of the invaded and uninvaded zones, and an estimate of formation temperature. Interpretation can be easily performed with nomographs which are provided.

Electrical Resistivity of Oil Field Brines in Mississippi and Alabama. M. E. Hawkins and O. W. Jones. *Petrol. Eng. 30,* B-40 (1958) Nov. (7 pp.)

Requests for previous reports on water resistivity have indicated a need for this information by the petroleum industry. Therefore, water resistivity data have been compiled from 24 oil-productive counties in Mississippi and Alabama. Average water-resistivity data presented represent measured and calculated values of produced brines from approximately 1000 wells in 116 fields.

Offshore Operations

Concrete Pile Foundations for Over-Water Drillsites. G. A. McCammon. *Drilling 19,* 69 (1958) Oct. (3 pp.)

Creole is marking its 25th anniversary of the first modern concrete pile derrick foundation, the standard used for all its wells in Lake Maracaibo since 1933. Reason for use: initial low cost, long service life and simplified maintenance.

Permeability

Effect of Applied Pressure on the Conductivity, Porosity and Permeability of Sandstones. D. O. Wyble. *J. Petrol. Tech. 10,* 57 (1958) Nov. (3 pp.)

Pressurizing system was designed and built to apply a radial pressure of 5000 psi to rock samples. Samples of the Bradford, Weir and Kirkwood sandstones were subjected to radial pressures parallel and perpendicular to the bedding in the system and the changes in conductivity, porosity and permeability were determined. Asymptotic decreases in conductivity, porosity and Klinkenberg permeability were observed over the 0-3500 psi range. From these data, the increase of formation factor over the same range was calculated. Cementation exponent expressed in the Archie equation was found to increase with pressure.

Recycling

Gas Injection in Eastern Venezuela Field Increases Oil Recovery. W. R. Vowel. *J. Petrol. Tech 10,* 31 (1958) Nov. (3 pp.)

Recovery as of Jan. 1, 1958, amounted to 51 million bbl or 60% of the original oil in place. Evidence of gravity segregation was noted early in life of the field and as a result, recovery under primary depletion, estimated at 59% of the oil in place, would have been very good. However, early initiation of pressure maintenance by gas injection and exercising close control of producing operations will yield an ultimate recovery of approximately 70.5% of the original oil in place. The ideal nature of the reservoir and its very light oil (42° API) are conducive to such control, and accurate prediction of performance using established engineering techniques is facilitated.

Reservoir Engineering

Application of Decline Curves to Gravity-Drainage Reservoirs in the Stripper Stage. H. C. Lefkovits

and C. S. Matthews. *J. Petrol. Tech. 10,* 275 (1958) Nov. (6 pp.)

Practical method is presented for fitting a general hyperbolic decline to production decline data. When this method is used, the index of decline observed in gravity-drainage reservoirs in the stripper stage when using only data over early years of decline usually agrees quite closely with that determined using data over 25 years or more. This indicates that the hyperbolic decline equation is reliable for predicting behavior of such reservoirs.

The Centrifugal Model. A New Technique for Studying Reservoir Behavior. R. J. Goodwin, C. G. Massey and P. B. Crawford. *Producers Monthly 22,* 15 (1958) Oct. (7 pp.)

Description of construction and operating results of the centrifugal reservoir model which has been used to study effect of oil properties, well location and producing rate on recovery of oil from a solution-gas-drive reservoir. Gravity segregation effects were minimized by slow rotation of the model about a horizontal axis. Studies were conducted on a synthetic porous media having a permeability of less than 10 md; bubble point of crude oil ranged from a few hundred to over 2000 psi; connate water was present.

Determine the Size of a Gas Reservoir. F. W. Cole. *World Oil 147,* 158 (1958) Dec.

Material balance equation for a gas reservoir can be used in conjunction with volumetric equation to determine approximate number of acres occupied by the reservoir. This technique is particularly advantageous when a well has been drilled into a new gas reservoir and it is desired to know the size of the reservoir in order to determine whether additional wells can, or should, be drilled.

Higher Residual Gas Saturation. S. G. Dardaganian. *Petrol. Eng. 30,* B-30 (1958) Nov. (5 pp.)

Higher initial gas saturation results in higher residual gas saturation, up to a point, and a higher percentage of oil recovery. Study shows how residual gas saturation is affected by initial gas saturation, porosity and fluid viscosity . . . and correlates results with previous studies.

Secondary Recovery

Field Results of South Belridge Thermal Recovery Experiment. C. F. Gates and H. J. Ramey, Jr. *J. Petrol. Tech. 10,* 236 (1958) Oct. (9 pp.)

Results of a field research project on thermal recovery of oil by movement of a combustion front are presented. Test was conducted in the South Belridge field, Calif. Pattern was a single 2.5-acre five-spot pattern in 700-ft deep Tulare sand. Results indicate feasibility of producing high viscosity, low-gravity crude oils by thermal means. It was demonstrated that heavy oils could be moved rapidly over considerable distances by thermal drive and that high percentage recoveries of oil could be effected. Bulk of oil recovery came after arrival of burning front at a production well. However, rapid corrosion and high-temperature failure of conventional pipe and equipment both below and above surface occurred. Oxygen was seldom observed in gas from wells ahead of the burning front, and it appears that the front was continuous throughout the experiment.

Improving Miscible Displacement by Gas-Water Injection. B. H. Caudle and A. B. Dyes. *J. Petrol. Tech. 10,* 281 (1958) Nov. (4 pp.)

Miscible displacement recovers all oil in the area contacted by the injected fluid, whereas water or immiscible gas drives usually leave substantial amounts of oil as residual. However, the poor mobility ratios associated with a gas-driven miscible displacement cause the sweep pattern efficiency to be much lower than that obtained with water flooding. One way in which the sweep efficiency in a miscible displacement process can be increased is by decreasing the mobility behind the flooding front. This can be achieved by injecting water along with the gas which drives the miscible slug. This water reduces the relative permeability to gas in this area and thus lowers total mobility.

Well Practice

Humble Has New Completion Method. *Oil Gas J. 56,* 136 (1958) Nov. 17 (2 pp.)

Casing serves as tubing, and unique perforator is used in multiple, tubingless completions. Cost-saving method eliminates entire oil string and tubing packers of conventional multiple completions.

Intermittent Gas Life Operation Is Successful. W. P. Massey. *World Oil 147,* 108 (1958) Dec. (3 pp.)

Review of latest equipment considerations and techniques applied to intermittent gas lift of parallel string and dual completions. Excellent results have been obtained in West Texas by applying methods discussed.

Plug Back Casing without Removing Tubing. L. W. Toelke. *Petrol. Eng. 30,* B-91 (1958) Dec. (4 pp.)

Host of field jobs demonstrate practicability of a new drillable through-tubing bridge plug. Cement is spotted by a wire line dump bailer with a full opening bottom electrically released.

Specialized Well Servicing Equipment. J. E. Shea. *Petrol. Eng. 30,* B-32 (1958) Dec. (3 pp.)

Any offshore operation is expensive and swabbing in a dead offshore well is no exception. Innovations

to lower these costs are of high interest to offshore operators. Main objectives in design of offshore unit to operate in Gulf of Mexico was to build a "sectionalized" swabbing unit that could be easily loaded and unloaded from barge to platform and vice versa, without use of special and expensive handling equipment.

Time-Cycle Intermitters, Plunger-Lifts Boost Output. A. J. Dudenhoeffer. *World Oil 147,* 101 (1958) Dec. (4 pp.)

With more than 3400 producing gas wells in the San Juan basine, operators are concerned with most efficient and economical production methods available. Article discusses problems associated with natural gas production in area as well as various corrective methods used to overcome them.

Well Stimulation

Gas Well Stimulation Increases Production and Profits. P. Clinkenbeard, J. F. Bozeman and R. D. Davidson. *J. Petrol. Tech. 10,* 21 (1958) Nov. (4 pp.)

Various acidizing and fracturing techniques have been developed to meet gas well stimulation problems. Case histories from four major gas producing areas show that considering such problems on an individual well basis, in light of previous experience in the area, allows planning each stimulation treatment for maximum effectiveness. Despite the common opinion that stimulating old gas wells is unprofitable, results show that stimulating such wells has often resulted in substantial and profitable production increases.

Preliminary Report on Fracturing by Vibration—A New Method of Well Stimulation. H. A. Metzger. *J. Petrol. Tech. 10,* 13 (1958) Nov. (4 pp.)

Vibration fracturing is a new method of well stimulation which may be used in either cased or uncased wells. In a cased well, the interval to be fractured is prepared by perforating the interval with a special-type vibro perforator. A specially designed explosive charge is run on a wire line and activated under a fluid column. Charge is designed to fracture the formation horizontally or weaken it so that it will take normal sand fracturing or acidizing at lower pressures. This fracturing is accomplished by setting up a large number of impulses or vibrating pressure waves along a horizontal plane. This preliminary report is designed to give the results of the use of this new method of well stimulation in various types of formation in the Texas and Mid-Continent area, and covers the time interval from February through June, 1958.

Petroleum Production

Recovery of Viscous Crude Oil. E. F. Pevere and H. E. Vermillion (assigned to The Texas Co.) U. S. 2,857,002 (1958) Oct. 21.

Heavy viscous crude oil is produced by in situ hydrogenation to reduce viscosity and increase drainage. Hydrogen feed and formation are preheated electrically, and entrance holes to the formation are drilled horizontally.

4. GAS CONDITIONING AND LPG RECOVERY

Condensate Recovery

Big Gas Field Is Rich in Condensate. *Oil Gas J. 56,* 140 (1958) Nov. 17 (2 pp.)

Completion of twelfth huge gas well boosts Port Acres (Texas) field's rated open-flow potential to 1,044,878,000 CF/day. Total potential condensate production is now more than 65,200 bbl/day.

Dust

On the Behavior of Liquid Droplets after Impinging on Solid Surfaces. I. Gallily and V. K. LaMer. *J. Phys. Chem. 62,* 1295 (1958) Oct. (5 pp.)

Deposition of particles impinging on solid surfaces was investigated for a system composed of a two-dimensional jet of glycerol aerosol and Desicote-coated glass microscope slides inclined to it. Patterns of particles deposited in these experiments were found to change with velocity of the jet and radius of the aerosol contrary to the way usually expected. They indicate that a certain fraction of the particles bounces off from the surface on first contact. Qualitative explanation of phenomena found is offered.

Influence of Power Input on Efficiency of Dust Scrubbers. K. T. Semrau, C. W. Marynowski, K. E. Lunde and C. E. Lapple. *Ind. Eng. Chem. 50,* 1615 (1958) Nov. (6 pp.)

Performance of Venturi, cyclonic spray and pipeline scrubbers on dust and fume from a black-liquor recovery furnace and a lime kiln with investigated on a pilot plant scale. Cold water was the scrubbing liquid in the first two devices, and hot recirculated solution in the third. Efficiency data were correlated on the basis of total theoretical power input per unit of gas flow rate. Venturi and cyclonic spray scrubbers gave substantially the same efficiency when operated at the same power input. Their efficiency on recovery furnace fumes was higher than the pipeline scrubber's, but this is believed to be due to condensation effects resulting from cold scrubbing water and not to scrubber characteristics. All three devices gave comparable performance on lime kiln dust, within the precision of the data.

Hydrogen Sulfide Removal

Newest Sulfur Recovery Process. F. M. Townsend and L. S. Reid. *Petrol. Refiner 37,* 263 (1958) Nov. (4 pp.)

Unique catalytic action of triethylene glycol on $H_2S + SO_2$ reaction has been developed to the pilot plant stage. Some principal features include: 1) simultaneous gas sweetening and surfur recovery; 2) insensitivity to carbon dioxide in process gas stream; 3) effective dehydration of the residue gas; 4) highly flexible and easily adapted to complete range of hydrogen sulfide concentration in the process gas stream; 5) recovery efficiency that may exceed 95% in sulfur recovery operations, and 6) process may be designed to replace the Claus process in converting acid gases from amine-type gas treaters for it is especially effective where carbon dioxide and/or heavy hydrocarbon contents of these mixtures are excessively high.

Hot Potash Process Purifies Gas at Lone Star's Fashing Plant. J. H. Crow and J. R. Dungan. *Oil Gas J. 56,* 97 (1958) Nov. 24 (3 pp.)

Capacity of 100 million CF/day probably makes this plant (Fashing, Texas) the world's largest natural gas treating plant to use hot-potash process. Natural gas feed of the plant contains a total of 9.4% hydrogen sulfide and carbon dioxide which must be removed prior to pipeline delivery. Following potash treatment gas gets a final purification using aqueous MEA solution.

Try Gas Treating with Hot Carbonate. B. O. Buck and A. R. S. Leitch. *Petrol. Refiner 37,* 241 (1948) Nov. (6 pp.)

Hot carbonate process, new tool to achieve economical treating of natural gases having high acid gas content, has advantages best realized at pressures above 250 psi and with gas concentrations from 5-50% acid gas on the inlet, with extraction of acid gases to a purity as low as 0.5%. Great purity requires special consideration. Such considerations will allow reduction of hydrogen sulfide content to less than 0.25 grains H_2S/100 scf, which is the common pipe line specification for natural gas. Features of special combinations of other processes with the hot carbonate process are outlined. Basic factors governing operation of commercial plants, data on solution equilibria and economics of process are discussed.

LPG

The Pincher Creek Gas Processing Plant. *Petrol. Eng. 30,* C-43 (1958) Nov. (2 pp.)

New Pincher Creek, Alberta, gas processing plant is largest single gas supplier to Trans-Canada pipeline. It is expected that the plant (feed gas capacity is 120 MMCF/day with provisions for expansion) will send an average of 70 MMCF daily to the line during the first year. Initial daily capacity for natural gas-derived products at the $25 million plant is 25,000 gal of propane, 40,000 gal of butane, 450 long tons of sulfur and an undisclosed amount of condensate.

Phase Equilibria

The Importance of Reliable Data in Gas-Condensate Recovery Calculations. R. F. Hinds. *J. Petrol. Tech. 10,* 60 (1958) Nov. (3 pp.)

Presentation of phase-behavior data that points out some of the important variables that influence recovery from gas-condensate reservoirs produced by pressure depletion. All these variables may be resolved into two major categories: the hydrocarbon composition of the reservoir fluid and the physical properties of the reservoir. Variables considered in article are those which are usually determined from well tests shortly after discovery, namely: 1) producing separator gas-stock-tank liquid ratio, 2) stock-tank liquid gravity, and 3) reservoir temperature.

Hydrogen Cyanide Removal

Treatment of Fluids for Removal of Hydrogen Cyanide. J. H. Karchmer and M. T. Walker (assigned to Esso Research and Engineering Co.) U. S. 2,859,090 (1958) Nov. 4.

In the cracking of nitrogen-bearing feedstocks, the hydrogen cyanide in the product gases is removed (in the presence of sulfides) by reaction with water-soluble aldehydes (acetaldehyde) in a molar ratio (with cyanide ion) of 1:1 or 6:1, injected at *p*H 8-11 into the gas stream or into a mixing chamber.

5. NATURAL GAS TRANSMISSION

Automation

The Outlook for Automation in Gas Transmission Systems. A. L. Vaughan. *Pipe Line News 30,* 65 (1958) Nov. (6 pp.)

Author believes that automation in the future is limited only by imagination of engineers and designers and investment which can be economically justified. Speed with which automation program will move forward will depend greatly on calculated risks, which management is willing to take, and growth rate of the gas transmission industry. Author describes experiences of his own company, Northern Natural Gas, which currently has five stations on its transmission system that are pushbutton controlled and ten other stations wherein newly-installed engines are automatically controlled.

Communications

Trans-Canada Communications. *World Petrol. 29,* 44 (1958) Oct. (2 pp.)

Two separate telephone networks provide means of communication along 2300-mile Trans-Canada route. Actual construction of circuits evolved as a flexible arrangement to meet changing needs of pipeline company. One system, although primarily designed as an operating line, became a communications network used mainly by construction and testing crews during building of the pipeline. The other, originally intended for administrative purposes only, will be converted to form the backbone communications facilities for pipeline operations.

Compressors

Series-Parallel Centrifugal Compressor Provides Pumping Flexibility. R. E. Schuhmann. *Pipe Line Ind. 9,* 45 (1958) Oct. (6 pp.); *Petrol. Eng. 30,* D-19 (1958) Nov. (5 pp.)

Unique compressor design gives operating flexibility of reciprocating stations to turbine driven-centrifugal stations over normal compression ratios. Actually two compressors in one case, the unit consists of four impellers. Polytropic efficiencies as high as 80% have been obtained with new designs.

Compressor Stations

48,500 hp for Trans-Canada. *World Petrol. 29,* 36 (1958) Oct. (4 pp.)

Ultimately, Trans-Canada's line may boast over 20 compressor stations. Twelve have been installed to date. All are reciprocating-type, but within the next two years at least two centrifugal compressors will be installed. To date, all compressors use the lines' gas for fuel, but this may change, particularly at new stations in northern Ontario.

How TGT Uses Computers to Analyze Compressor Station Operations. J. T. Manry III. *Pipe Line Ind. 9,* 55 (1958) Oct. (5 pp.)

Operating records of more than 500 engines are being continuously studied by Tennessee Gas Transmission Company's electronic computer planning team to produce timely and accurate reports for operating management evaluation. Data from daily compressor station reports are fed into the computer along with fixed master card data to quickly generate a report which shows horsepower-hours runs, calculated sweep volumes, oil use, repairs and various operating conditions for each engine. Answers sought in future studies may include such items as best time for crankshaft renewals, spare parts stocks need and where, most efficient combination of engines, and optimum loading conditions for stations on the line.

United Gas Fits Automation to Oldtimers. C. Epps and C. L. Walters. *Pipe Line Ind. 9,* 50 (1958) Nov. (2 pp.)

To gain some of the advantages of automatic control on those compressor stations with up to 30 years of service, United Gas Pipe Line Company installed 35 simply designed, shop fabricated supervisory panel boards. Circuitry is kept simple, using standard relays, sockets and lamps. Safety with low power rating and wiring scheme, plus interchangeability of parts or entire panels, makes for ease in trouble-shooting.

Pipeline Construction

Dents in Pipe. S. P. Belonos and R. S. Ryan. *Oil Gas J. 56,* 155 (1958) Nov. 17 (4 pp.)

Tests indicate that the metal in and adjacent to a dent contains some residual stresses even though the metal yields. Magnitude for this residual stress, obtained by use of strain gages, increases with depth of dent and decreases with dent area.

Electrical Features of the Four Corners Line. J. J. Sonnier and H. N. Siler. *Pipe Line News 30,* 40 (1958) Nov. (11 pp.)

General discussion of electrical power distribution systems, control schemes, supervisory control, telemetering and communication means employed on a crude oil pipeline construction by the Shell Pipe Line Corp Line, commonly known as the Four Corners Pipe Line, runs from the San Juan and Paradox basins to the refinery area in or near Los Angeles.

High Pressure Pipelines in Gas Industry. A. D. L. Copp. *Gas World 148,* 874 (1958) Nov. 8 (2 pp.)

Summary of a discussion on construction, operation and future use of high pressure pipelines in the gas industry. As an example, author used a 24-in. diameter pipeline which has been constructed for the North Thames Gas Board to carry incondensable gas from oil refineries at Thameshaven for treatment at the Romford gasworks, a distance of 24½ miles.

Looping with New X-56 Pipe. P. Reed and G. Kinney. *Oil Gas J. 56,* 80 (1958) No. 24 (3 pp.)

Gulf Interstate has found that methods for laying X-56 electric-weld pipe are basically the same as those for X-52. Standard welding procedures had to be modified only slightly and no changes were needed in bending operations.

Pre-Cambrian Problems on Trans-Canada Job. L. O. Rowland. *World Petrol. 29,* 41 (1958) Oct. (3 pp.)

World's longest gas line also was toughest to dig. Nearly half the total pipeline mileage between Hadashville, Manitoba and Montreal was constructed

in spite of rock varying in thickness from a few inches to heights of as much as 1400 ft. Basic problem devolves around peculiar rock composition.

Safety in the Trench. *Construction Methods and Equipment 40,* 81 (1958) Nov.

Pair of unusual trench shields help make construction of the $12-million Santa Ana Pipeline in Southern California a safe and rapid job. One is a steel housing that safeguards workmen during fine grading of the trench floor; the other is a half-circle steel cage that protects welders.

Pipeline Systems

Two Stations Only for 512-Mile System. F. H. Love. *Petrol. Eng. 30,* D-30 (1958) Nov. (3 pp.)

Start of operations recently by Texas-New Mexico Pipe Line Company's system between Aneth, Utah, and Jal, New Mexico, gave prolific Four Corners area its second pipeline outlet. It also marked first time Four Corners oil could be shipped to markets in the Gulf Coast, Mid-Continent and Chicago areas by means of existing pipelines. Initially the capacity of this 512-mile, 16-in. line is 50,000 bbl/day with two pumping stations. Maximum operating pressure is 1000 psi; present pressure is approximately 850 psi.

Oil in Siberia. G. G. Rosu. *World Petrol. 29,* 48 (1958) Oct. (5 pp.)

Vast arterial network of pipelines is being built to supply Siberia and Soviet Asia. Potential of this area is great and over half of Russia's investment is now going into it.

Welding

New German Magnetic Girdle Makes Automatic Field Weld Practical. M. A. Judah. *Pipe Line Ind. 9,* 42 (1958) Nov. (4 pp.); **Automatic Welding on the Right-of-Way.** D. M. Taylor. *Petrol. Eng. 30,* D-24 (1958) Dec. (2 pp.)

Heart of magnetic welding system is intricately designed girdle that holds rod in position. Its segments are linked together so that it resembles a giant caterpillar gripped over the joint. Weld current and field current for the girdle is supplied by a single phase, 15 KVA, 400-volt generator driven at 3000 rpm; A.C. welding circuit power is 100 volts on open circuit at 100 cps. Three phase, 5 KVA auxiliary generator supplies 50-cycle A.C. at 380 volts for ventilating blowers, bevelling machine, grinders and other electric hand tools. More than 20 miles of 8-12-in. utility lines have been field welded in Germany using this new system.

Pipeline Welding Techniques. P. Trippe. *Chem. & Process Eng. 39,* 406 (1958) Nov. (5 pp.)

Without modern welding techniques, many of them developed for the chemical and process industries, these industries as they appear today could never have evolved. It is in the lines of communication—the pipelines—that welding has made one of its most significant contributions. Article describes latest techniques.

Pipe Welding Terms Defined. H. Thielsch. *Heating, Piping & Air Conditioning 30,* 133 (1958) Nov. (4 pp.)

Comprehensive list of welding terms is given in alphabetic order.

Safe Welding on Gas-Filled Pipelines. J. S. Powell and H. M. Curtis. *Oil Gas J. 56,* 135 (1958) Nov. 10 (4 pp.)

Southern California Gas Co. tests show that air should be purged with gas before welding is done, practice of "drifting gas" does not prevent air from entering the line, purging should be done through a bottom opening and controlled-fired welding is safe only if welder progressively "muds" behind cut.

Fluid Flow

Silencer for Positive Pressure Gas Streams Subjected to High Amplitude Pulsations. R. B. Bourne (assigned to The Maxim Silencer Co.) U. S. 2,857,-014 (1958) Oct. 21.

Cylindrical shell silencing chamber for pulsating gas streams is claimed, with a side inlet manifold, feeding gas inward to a central axial outlet pipe and connected to it by several perforations of reduced area, and also connected to acoustically-coupled side chambers formed by partitions in the main shell.

Pipeline Operations

Detecting Means for Locating Pipeline Scraper. K. D. Savage (assigned to The Texas Co.) U. S. 2,856,884 (1958) Oct. 21.

Detection device is claimed for locating a stuck scraper in a pipeline. This consists of an attached sonic generator comprised of a metal ball which is rolled by jets of the pipeline gas making contact circumferentially around a circular cage formed of rods, or of a ring with slots, which generate sound as the gas flows past.

6. GAS AND LPG STORAGE

Gas Holders

Aboveground High Pressure Gas Holders. H. Geilenkeuser. *Gas- u. Wasserfach 99,* 1093 (1958) Oct. 24 (6 pp. German text.)

Author discusses revised 1957 German construction and design standard, DIN 3396, for spherical, high pressure gas holders, with respect to safety, materials, welding, pipe connections, testing and operating conditions of filling and emptying.

LPG Storage

Bottled Gas Corp. of Va. Tank Farm Features Three 74,000 Gal. Vessels. E. O. N. Williams. *Butane-Propane News 20,* 33 (1958) Nov. (2 pp.)

For six years, the Bottled Gas Corporation of Virginia, Richmond, has explored various means of providing its plants and customers with adequate storage to see it through at least two weeks of peak wintertime consumption. Answer came in the form of a tank farm consisting of three king-size tanks, each capable of holding 74,000 gal.

Tanks

Gaging Chart for Cylindrical Tanks. *Air Conditioning, Heating and Ventilating 55,* 65 (1958) Nov. (6 pp.)

Gaging chart permits rapid calculation of contents of partially filled horizontal, spherical and vertical cylindrical tanks with different types of heads. Until its development, process of gaging cylindrical tanks involved either a long and involved calculation or use of water.

Russians Claim They Are Building "Roll-Type" Prefabricated Tanks. *Oil Gas J. 56,* 42 (1958) Nov. 24 (2 pp.)

Basic principle of Russian method is welding of steel sheets to form a tank wall into a single piece. Sheet then is rolled and moved to the erection site. Tank bottom and roof panels are transported separately. Russians claim a small crane and 7-man crew can erect a 31,460-bbl tank in 8-10 days. When separate plates were welded at tank site, job took a 20-man crew 45-60 days to complete the job.

Underground Storage

LP-Gas Underground Storage. C. T. Brandt. *LP-Gas 18,* 48 (1958) Dec. (4 pp.)

Underground storage, once a novelty, now is an accepted phase of the LPG business. Companies contemplating underground storage for the first time appear primarily interested in the cost. When this has been answered, they ask what physical, geological requirements must be met before the construction of an underground cavern can be contemplated. Then they ask what investigations are necessary and, finally, how long it will be before they can expect to have such storage complete and in operation. Article tries to answer these questions and to provide a useful guide to those contemplating underground storage of LPG.

Temperature Logs Aid Gas Storage Well Analysis. J. M. Bird and J. C. Dempsey. *World Oil 147,* 128 (1958) Dec. (3 pp.)

Temperature logs can help reservoir engineers concerned with storage problems. particularly as gas storage becomes more widespread and more sensitive temperature recording devices are developed and put into use. New quantitative and qualitative analytical techniques have been developed to establish temperature conditions as a function of rates of gas production and injection, and the exchange of heat between the gas and underground formations. After considerable research on gas storage problems in the Appalachian province, a practical analysis of thermal behavior of gas storage wells has been presented.

Methane Liquefaction

Means for Controlling the Pressure in an Insulated Tank Containing Liquefied Methane. W. L. Morrison (assigned to Constock Liquid Methane Corp.) U. S. 2,856,044 (1958) Oct. 21.

Pressure regulating device is claimed for maintenance of pressure in a liquefied methane tank at about 0.25 psi. Bellows, actuated by tank pressure, provides high and low electrical contacts for operating, respectively, a solenoid vent-valve to release pressure to an air duct, and an electric (or other) heater to evaporate more liquid methane. Vent-valve may also include means for increasing air flow through the air duct by a blower with increasing methane pressure.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Acetylene

Design Tips for Acetylene Equipment. J. W. Haun. *Petrol. Refiner 37,* 204 (1958) No. (4 pp.)

Design criteria help avoid usual hazards of acetylene processing. Successful design of equipment at any pressure requires thorough understanding of decomposition behavior of the gas. Equipment design and process design are intimately related and again must be based on a basic understanding of the behavior of the gas. All design approaches must attempt either completely to eliminate possibility of decompositions or to prevent their propagation once started. Deflagrations must be localized before cascading effects develop and detonation conditions are set up.

Newest Acetylene Process—SBA—Kellogg. J. L. Patton, G. C. Grubb and K. F. Stephenson. *Petrol. Refiner 37,* 180 (1958) Nov. (7 pp.)

Extensive collaboration between Societe Belge de l'Azote and The M. W. Kellogg Company has made available to the petroleum and petrochemical industries an improved process for the manufacture of high purity acetylene from natural gas, naphtha or other liquid feedstocks. Available on a commercial

basis and completely proved in pilot plant operation, this process offers eight cent acetylene from naphtha. Complete economic data and operation description are included.

The Selective Hydrogenation of Acetylene. G. C. Bond, D. A. Dowden and N. Mackenzie. *Trans. Faraday Soc. 54,* 1537 (1958) Oct. (10 pp.)

Study has been conducted of the degree of selectivity of ethylene formation in the hydrogenation of acetylene catalyzed by rhodium, palladium, platinum and some palladium + silver mixtures supported on α-Al_2O_3. Analyses were performed by gas-liquid chromatography. Thermodynamic and mechanistic factors in selectivity are discussed, and probable role of dissolved hydrogen in determining selectivity of palladium catalysts is outlined.

Ammonia

Ammonia—Long Term Outlook Good. R. P. Westerhoff. *Petrol. Eng. 30,* C-26 (1958) Nov. (2 pp.)

Synthetic ammonia industry, main source of chemical nitrogen fertilizer, will have to increase capacity about 80% to meet farm and industrial needs by 1975. At today's costs, this will represent capital outlays of approximately $400 million. Existing ammonia capacity, with a value of some $500 million, totals about 5 million tons/year and leads the petrochemical industry in terms of tonnage.

Aromatics

How to Separate Xylenes for Profit. J. A. Weedman and R. A. Findlay. *Petrol. Refiner 37,* 195 (1958) Nov. (6 pp.)

Petroleum xylenes, now available in many refineries from catalytic reforming processes teamed up with solvent extraction facilities, can be separated into four pure hydrocarbons for chemical intermediates: ethylbenzene, *p*-Xylene, *m*-Xylene and *o*-Xylene. Advantages and disadvantages of four methods—fractionization, crystallization, extraction and selective sulfonation—of xylene separation are described. Most economical production method of pure xylenes combines best features of these processes.

Look Carefully at BTX Aromatics. L. F. Hatch. *Petrol. Refiner 37,* 174 (1958) Nov. (6 pp.)

Potential of petroleum as a source of BTX is unlimited. It is estimated that currently only 11% of available benzene, 6% of toluene and 4% of xylenes are recovered for chemical use. Chemical industry is in competition with octane requirement of motor fuel for these aromatic hydrocarbons. In the past petroleum aromatics had a distinct advantage over coke oven aromatics because of their greater purity. This may not be so pronounced in the future.

New Processes for the Treatment of Benzol. Part 1. *Coke and Gas 20,* 415 (1958) Oct. (4 pp.); Part 2. *Ibid.,* 465 (1958) Nov. (7 pp.)

Part 1 reviews BASF-Scholven process for the pressure rectification of benzol, while Part 2 describes central distillation plant for pressure refined benzol at Gelsenkirchen. Material is largely based on information given by Heinrich Koppers G.m.b.H.

Butadiene

Italy's Natural Gas Used to Obtain Rubber and Fertilizers. *Gas World 148,* 768 (1958) Oct. 25 (4 pp.); **Petrochemicals in Italy.** *World Petrol. 29,* 72 (1958) Nov. (3 pp.)

ANIC-ENI plant near Ravenna is described. Acetylene from partial oxidation of methane is catalytically oxidized to acetaldehyde and this is hydrogenated to butadiene. Latter is copolymerized with styrene to form rubber, of which 5500 tons/year is produced.

Carbonization

Insight into the Coking Process: Contribution on Coke Production from Gas Coals. H. Barking and C. Eymann. *Gas- u. Wasserfach 99,* 1038 (1958) Oct. 10 (9 pp. German text.)

Observations during research on production of iron-coke at Walsum Bergwerke GmbH have given further insight into processes of carbonization. These have importance in expanding supply of raw materials for iron production not only in Germany and Europe but throughout the world. Studies of porosity, fillers, swelling index, dilatometer, expansion pressure, coke yields and properties, effects of blending and of inert additions are presented.

Coal

Chemical Structure of Coals: A Method for Comparing Data of Different Origins and for Testing Sets of Data for Self-consistency. I. G. C. Dryden. *Fuel 37,* 444 (1958) Oct. (25 pp.)

Extension of earlier methods of statistical structural analysis has enabled a comparison to be made on a common basis between 1) measurements on coal by X-ray diffraction, infrared spectrometry and nuclear magnetic resonance, and 2) deductions by statistical structural methods from measurements of density, refractive index and heat of combustion. Unsuspected discrepancies are revealed. Structural parameters derived from measurements by the first three methods can be brought into approximate mutual agreement by making suitable and not unreasonable modifications to the structural assumptions. But the second group gives parameters that cannot be brought into agreement; these are more widely scattered and fall on both sides of those of the first group. A self-

consistent set of parameters describing the variation of coal structure with rank is derived from the mathematical analysis of results from the first three methods and its implications are noted.

Coal Gasification

Lurgi. A Review of the System for High Pressure Gasification. L. Walter. *Gas World 148,* 822 (1958) Nov. 1 (4 pp.)

General features of the Lurgi process are reviewed, including brief descriptions of all commercial plants. New plant under construction at Westfield (Scotland) is discussed.

Slagging Slices in Gasification Costs. *Chem. Week 83,* 53 (1958) Nov. 29 (3 pp.)

U.S. Bureau of Mines is completing a new fixed-bed pressure gasification pilot plant, designed to produce synthesis gas from lignite, at Grand Forks, N.D. Scheduled to go into operation early next year, pilot unit will give management its best look at economic advantages of operating a Lurgi-type gasification process under slagging conditions.

Coal Properties

The Spreading of Oil on Wet Coal. D. J. Brown. V. R. Gray and A. W. Jackson. *J. Appl. Chem. 8,* 752 (1958) Nov. (8 pp.)

Spreading of oil on wet coal is shown, theoretically, to depend on two factors: the water/oil/coal contact angle and the oil/water interfacial tension. From these factors two criteria of spreading can be derived: the 'spreading coefficient' and the 'adhesion tension' relating to spreading on flat surfaces and spreading into capillaries, respectively. These criteria were calculated from measurements with pure oils, and with impure oils containing varying amounts of surface-active agent to find the conditions most conducive to good spreading.

Ethylene

Ethylene—Petrochemical Genie. L. F. Hatch. *Petrol. Refiner 37,* 214 (1958) Nov. (10 pp.)

Small molecule has developed into one of the most dynamic of all petrochemical starting materials. Future of ethylene is closely related to five types of compounds which account for over 90% of ethylene consumption. They are ethylene oxide, ethyl alcohol, polyethylene, haloethylenes and ethylbenzene. Ethylene oxide, ethyl alcohol and ethylbenzene are in the billion pound/year class and polyethylene capacity is over a billion pounds but current production is about 800 million pounds/year.

Gasification

The Changing Pattern of Gas Manufacture. A. R. Myhill. **Part 1. The Raw Materials Question.** *Chem. & Process Eng. 39,* 308 (1958) Sept. (3 pp.); **Part 2. The New Techniques.** *Ibid.,* 396 (1958) Nov. (4 pp.)

Until very recently, manufacture of town gas could well have been described as a remarkably conservative industry producing the bulk of its products by methods differing but little from those used by Murdoch over 150 years ago. Factors influencing supplies of raw materials, however, coupled with proved possibilities shown by research, are now indicating the way to a new pattern of the gas industry which will employ entirely new methods of manufacture and supply. Part 1 describes completely new methods of making gas from coal without coproduction of coke. Principles upon which these methods are based are discussed in Part 2.

Hydrogen

The *P, T, x* Relationships of H_2+HD and H_2+D_2 Mixtures between 18° and 28°K. R. B. Newman and L. C. Jackson. *Trans. Faraday Soc. 54,* 1481 (1958) Oct. (11 pp.)

Preparation and distillation of HD and D_2 are described and a comparison made between their vapor pressure curves and those for normal hydrogen from 18°-28.5°K. Dew- and boiling-point method has been used to investigate the *P, T, x* relationships for H_2+D_2 and H_2+HD mixtures in the same temperature range. Deviations from Raoult's law are greater for dew-points than for boiling points, but do not exceed 4%.

Petroleum Refining

Catalytic Reforming. N. J. Emms. *Can. J. Chem. Eng. 36,* 267 (1958) Dec. (4 pp.)

Description of catalytic reforming process for upgrading naphtha feedstocks to high octanes using a regenerable platinum catalyst. Particular reference is made to the Powerforming process developed by Esso Research and Engineering Company and in use by Imperial Oil Limited. The various types of fixed bed units are described and a simplified flow plan of a typical Powerforming unit is illustrated. General operation of the unit is discussed as well as the primary reactions involved in catalytic reforming. Operating conditions are listed and some product yields and quality are shown in a table for various feedbacks.

Plant Wastes

Sulfur Takes Over at Spindletop. *Chem. Eng. 65,* Nov. 17 (4 pp.)

Land-bound sulfur mining is modern operation at Texas Gulf Sulfur's Spindletop. Especially noteworthy are the plant's waste disposal problem and the process developed to handle it. Because the mine is near heavily populated Beaumont and remote from large bodies of water, disposal of its more than million gal/day of waste water presented difficulties.

Radioactivity Applications

Nuclear Radiation in Chemical Processing. F. T. Barr, H. J. Ogorzaly and T. A. Reiter. *Petrol. Eng. 30,* C-48 (1958) Nov. (4 pp.)

Results of study to determine potential uses of radiation processing indicates: 1) radioisotopes, electron accelerators and nuclear reactors can all be used as commercial sources of process radiation, on the basis of known technology; 2) while small amounts of radioactivity might be present in products from nuclear reactor radiation, prospects for satisfactorily limiting this are promising; 3) in the reasonably near future, cobalt-60 radiation could be available for process radiation at $2.50/kwh, including return on investment; electron beam energy at $1/kwh and reactor irradiation at 15-35 cents/kwh. Size of the source affects cost more than type.

Rubber

Synthetic Rubber Production at Hythe. *Chem. and Ind.* 1432 (1958) Nov. 1 (3 pp.); **First Synthetic Rubber Plant in England Built in Record Time.** G. Weyermuller and D. A. Bennett. *Chem. Processing 21,* 75 (1958) Dec. (3 pp.)

New $6-million plant of the International Synthetic Rubber Co. Ltd., Britain's first venture in the bulk manufacture of general purpose synthetic rubber, is now producing at the rate of 40-50 thousand tons/year. Capacity is of the same are as that of the Hüls plant in Germany, and it is expected that output can be accelerated to between 70-90 thousand tons/year.

Acetylene

Acetylene Generation with an Electric Arc. E. F. Pevere and H. V. Hess (assigned to The Texas Co.) U.S. 2,858,261 (1958) Oct. 28.

Nitrogen and hydrocarbon gases are reacted in an intermittent electric arc, the former gas being fed through the hollow metallic electrode and the hydrocarbon added as a surrounding atmosphere, to produce acetylene and hydrogen cyanide which are withdrawn continuously with the product gases.

Carbon Disulfide

Method of Producing Carbon Disulfide and Hydrogen Sulfide by the Reaction of Sulfur and a Hydrogen Gas. R. W. Timmerman, A. G. Draeger and J. W. Getz (assigned to Food Machinery and Chemical Corp.) U. S. 2,857,250 (1958) Oct. 21.

Methane and sulfur-vapor are reacted in catalytic beds in three stages with preheating of feed to each stage to 625°C by furnace coils to avoid temperature drop during reaction and excessive overheating in heat exchangers in production of carbon disulfide and hydrogen sulfide.

Ethylene

Gas Separation. W. R. Partridge and F. L. Mahoney (assigned to The M. W. Kellogg Co.) U. S. 2,857,018 (1958) Oct. 21.

Rich gases from a refinery or a conversion process are scrubbed in a two-stage absorption-distillation process to recover C_2 hydrocarbons and ethylene as separate fractions (from a mixture of same with methane). Low-boiling absorbents (butane, gasoline) are used in first stage, and slightly heavier hydrocarbons in second stage to avoid losses of absorbent in off-gas stream. Pressures of 500-600 psig are used, and second absorbent rich oil is distilled to recover first absorbent as overhead and second absorbent as bottoms.

Process for the Production of Ethylene. K. Fischer and G. Rummert (assigned to Farbwerke Hoechst AKG.) U. S. 2,859,258 (1958) Nov. 4.

Improved ethylene yields are claimed for a two-stage cracking process for methane comprising a first-stage at 800°-1100°C and 5 kg/cm² pressure on Group II, III and IV metal oxide catalysts with separation of ethylene, and second-stage cracking of remaining gases at 600°-800°C. Unconverted gases may be further recycled to first stage after separation of ethylene.

Hydrogasification

Pressure Hydrogasification of Natural Gas Liquids and Petroleum Distillates. E. S. Pettyjohn and H. R. Linden (assigned to Institute of Gas Technology) U. S. 2,860,959 (1958) Nov. 18.

Improved process for converting natural gas liquids into a fuel gas completely interchangeable with natural gas is claimed. This comprises producing hydrogen by catalytic steam reforming of a hydrocarbon, mixing this hydrogen with a vaporized feedstock below cracking temperature, then increasing temperature to 1300°-1500°F at 50-80 psia to convert feed to a fuel gas. Waste heat from hydrogen-forming stage is used to preheat and vaporize feedstock.

Synthesis Gas

Process for the Production of Synthesis Gas Without Catalysts. G. G. Millian (assigned to Montecatini,

Soc. Gen. per l'Ind. Mineraria e Chimica.) U. S. 2,859,103 (1958) Nov. 4.

Improved production of synthesis gas is claimed by first mixing pure oxygen and methane in molar ratio of 0.5-0.8 by impinging together streams of the two gases at equal kinetic energies and introducing the mixture through a burner into a reaction zone held at not over 1000°C.

8. GAS DISTRIBUTION

Distribution Systems

Development and Coordination of Gas Grid Supplies from an Integrated Steel Works. J. T. Davies, W. F. Edwards, W. D. Rees and H. J. Victory. *Gas J. 296,* 297 (1958) Nov. 12 (2 pp.)

Western and Central sections of the South Wales gas grid soon will be completed. Main supply of gas for an area stretching from Mid-Glamorgan in the East to Cardigan Bay in the West and the Bristol Channel to Lampeter in the North is now being taken from the Margam coke oven works. Peak load or emergency c.w.g. plants situated at Aberavon, Swansea and Neath works are available when needed, and so are a butane plant at Aberavon and methane drainage from nearby collieries, but coke oven gas and blast furnace gas from the steelworks constitute the main supply.

The Development of the Wolverhampton District Grid. G. W. F. Cockayne. *Gas J. 296,* 302 (1958) Nov. 12 (7 pp.)

Abbreviated account of some of the work done in the Wolverhampton and District Division of the West Midlands Gas Board since 1950. Objectives at that time were: 1) survey of pressure conditions in each of the ten towns which comprise Wolverhampton District; 2) critical examination of distribution systems of each of these towns; 3) preparation of a scheme for integrating the ten works in the Division, and 4) institution of a code of good distribution practice.

Distribution of Flows in a Network. K. J. Stanton. Part 1. *Gas 34,* 57 (1958) Nov. (4 pp.); Part 2. *Ibid.,* 53 (1958) Dec. (5 pp.)

Review of basic principles of gas network analysis with electronic computers. Series is specifically designed for readers to whom the art of electronics in gas system calculations is "new".

Illinois Power Finds a Mechanical Jack-of-all-Trades. *Gas Age 122,* 30 (1958) Oct. 30 (3 pp.)

Specially designed portable crane's applications range from heavy yard handling duties to use in pipe tapping.

A Realistic Distribution Maintenance Program. J. H. Glamser. *Am. Gas J. 185,* 17 (1958) Nov. (4 pp.)

Three-phase program designed to solve maintenance problems can be evolved from complete data on leakage, soil resistivity, pipe condition and age, and details on repairs to system. Three phases are exploratory, remedial, preventative.

LPG

Pipe Dream in a Trailer Park. W. W. Clark. *Butane-Propane News 20,* 30 (1958) Nov. (3 pp.)

Bright Meadows Mobile Homes development near Lancaster, Pa., has provided piped gas for its tenants since it was opened late in 1956. In the beginning there were 18 units, today there are 50, with a waiting list of 25—and all trailers are LPG consumers. LPG is fed from a 1000 gal bulk tank through a 1½-in. underground piping system which carries the LPG at 15 lb pressure to utility vaults at each site where pressure is reduced and gas is metered.

Three Steps to Accurate Vapor Metering. M. G. Cook. *Butane-Propane News 20,* 36 (1958) Nov. (4 pp.)

Presentation of simplest practical method of bringing the billing for gas sold through meters in vapor form into balance with gas bought in liquid form and paid for on the basis of standard liquid temperature corrections.

Mains

Eastern Utility Inserts New Mains into Old Ones. *Gas 34,* 41 (1958) Dec. (4 pp.)

Con Edison (N. Y.) is replacing large, low-pressure mains with smaller higher pressure ones of several times the capacity. In Times Square, an old 24-in. main was replaced by a 16-in. tube over a distance of 1700 ft. Only 310 ft of the street (Broadway) was disturbed. Technique is still being improved, and is currently being used on a large main which will supply natural gas from the New York facilities line, across the East river from Manhattan.

Metering

Gyro-Integrating Mass Flowmeter. L. T. Akeley, L. A. Batchelder and D. S. Cleveland. *Trans. ASME 80,* 1849 (1958) Nov. (6 pp.)

Description of an integrating mass flowmeter designed for high pressure natural gas metering. Meter described provides direct reading of pounds of gas on a cyclometer register as well as electrical contacts for remote telemetering mass flow. No electronic elements are used in the design. A three-axis gyroscope is used for integrating. Meter is designed for 1%

integrating accuracy over 30-100% of rated flow. It operates over a 20 to 1 flow range.

The One-Pipe System. *Gas World 148,* 918 (1958) Nov. 15 (5 pp.)

First 400 trial one-pipe metering installations were made in 1953. National and local authorities, gas engineers, competitors and traditionalists have subjected the system to severe tests, but no difficulties have arisen in practice. Article describes system in detail and discusses advantages.

Weather Forecasting

Increasing Profits by Weather Engineering Studies. W. H. Roschke, Jr. *Gas 34,* 62 (1958) Dec. (5 pp.)

Scientifically made and properly applied analysis of past years' weather conditions appears to be one of the best answers to problems of planning for the future in a weather-affected business, such as the gas industry. Weather engineering study is significant in that it is "timeless"—it is just as useful 10 years from now as it is today. Such studies are particularly useful to smaller utility which may not require interpretive forecasting service.

Weather 3 Years Ahead. A Physical Basis for Seasonal Degree-Day Forecasts. I. P. Krick. *World Petrol. 29,* 46 (1958) Nov. (6 pp.)

Rapid progress has been accomplished in long-range weather forecasting techniques within the past five years. For the 1957-58 season, an accuracy of 86% has been attained in degree-day forecasts made ahead of the opening of the heating season. A vast library of data is being carded for computer use in developing forecasts by analogy.

9. GAS FUEL UTILIZATION AND APPLIANCES

Air Conditioning

Controls for Comfort Cooling with Gas Heating. G. T. Hastings. *Gas Heat and Comfort Cooling 9,* 29 (1958) Oct. (3 pp.)

Addition of cooling to conventional heating systems has necessitated changes in the controls that manage this equipment. An understanding of control systems is essential to heating and cooling work. Series outlines more popular control systems, noting their changes and improvements.

Eliminating Man-Made Fog. M. A. Ramsey. *Air Conditioning, Heating and Ventilating 55,* 55 (1958) Dec. (4 pp.)

Some fogs are man-made, such as that in discharge of a cooling tower, an evaporative condenser or in indoor swimming pools. Man-made fogs can be eliminated or cause of the fog removed. Approach suggested is that solution to a fog problem is just as definite a calculation as any other air conditioning problem. Practice, however, has often been a matter of trial and error. Explanation given will serve to eliminate haphazard experimentation and point to definite solution.

What Does Gas Air Conditioning Cost? Absorption System and Steam Turbine Driven Compressor System. H. C. Stuckeman. *Heating, Piping and Air Conditioning 30,* 109 (1958) Dec. (2 pp.)

Answer to above question is presented in terms of actual operating data from two air conditioned industrial plants. Conditions and costs are compared.

Which System Is Best? W. R. Barnard. *Air Conditioning Heating and Ventilating 55,* 59 (1958) Nov. (6 pp.)

Author selects four of the most popular of the many air conditioning systems available for multi-story buildings and argues case for one of these, the fan-coil unit perimeter system.

Air Pollution

Air Pollution Effects of Irradiated Automobile Exhaust as Related to Fuel Compositions. E. A. Shuck, H. W. Ford and E. R. Stephens. (San Marino, Calif.: The Air Pollution Foundation, Oct., 1958.)

"Photochemical smog" was produced by irradiating diluted automobile exhaust in a 520-cu. ft. chamber. Intensity of this smog was measured in terms of resulting symptoms of eye irritation, visibility reduction and ozone formation. While many other measurements were obtained, principal objective of this study was to determine effect of fuel composition on intensity of these three symptoms. Four fuels were studied, each containing different amounts of aromatic, olefinic and saturated hydrocarbons. These were in the range of 3-34% aromatics, 0-52% olefins and 24-97% saturated hydrocarbons. Five cars were used during this program. Under certain conditions, exhausts from all fuels led to appreciable eye irritation, and in these cases the olefin-containing fuels led to more reactive exhausts and more eye irritation than the non-olefinic fuels. Good correlations were found between eye irritation and the concentrations of certain C_4 and C_5 olefins in the exhaust while other hydrocarbons did not show such correlations. Quantity of aerosol formed by irradiation was dependent on both the olefin content and the sulfur content of the fuel. Maximum concentrations of ozone formed by irradiation of diluted exhaust were essentially independent of fuel composition.

Combustibility of Simulated Automobile Exhaust Gases. B. Greifer and R. Friedman. (San Marino, Calif.: Air Pollution Foundation, 1958, Sept.)

Combustibility of automobile exhaust gases has been studied to provide a sound basis for judging the feasibility of reducing atmospheric pollutants by means of noncatalytic afterburners for automobiles. Synthetic automobile exhaust gases were prepared and burned in the laboratory on a flat-flame burner capable of burning extremely weak (fuel-poor) mixtures. Mixtures tested embraced a wide range of burnable and nonburnable compositions, based on mass spectrometer analyses of actual automobile exhausts reported in the available literature. Equations and a correlation curve are presented which enable the flammability of an automobile exhaust to be predicted from a knowledge of its composition and temperature. For any oxygen-deficient mixture it is assumed that the stoichiometrically required quantity of secondary air has been added. On the basis of certain reported gas analyses, it is calculated that exhaust compositions corresponding to deceleration and idling conditions will burn if introduced into an ideal afterburner at 440°F. Exhaust gases corresponding to other engine operating conditions will be flammable only if they are assumed to enter the afterburner at much more elevated temperatures. In the most unfavorable case, which is the cruising condition, it is estimated that the exhaust would have to have a temperature of approximately 1240°F to be flammable.

Evaluation of Filters for Removing Irritants from Polluted Air. N. A. Richardson and W. C. Middleton. *Heating, Piping & Air Conditioning 30,* 147 (1958) Nov. (8 pp.)

Many of the tests conducted were performed with activated carbon filters varying in air detention time between 0.032 and 0.0030 sec. Significant decrease in irritation was recorded over entire range of air detention times. Differences in effectiveness with respect to air detention time were not statistically significant, although a trend of decreasing effectiveness was observed as air detention time was reduced. Effectiveness of activated carbon in removing oxidants was directly related to detention time. NO_2 was reduced by activated carbon during its early use.

Combustion

Basic Principles of Combustion-Model Research. A. A. Putnam and E. W. Ungar. (Trans. ASME, Paper No. 58-A-73).

Use of models to study problem encountered in design of commercial and industrial combustion equipment is less well known than use of their counterparts for aeronautical, hydraulic, erosion and similar studies. Basic assumptions upon which cold-flow modeling of combustion systems are carried out, application of modeling to various combustion problems and type of results that should be expected from application of modeling techniques are discussed.

Flame Research

The Concentration of Hydroxyl and of Oxygen Atoms in Gases from Lean Hydrogen-Air Flames. W. E. Kaskan. *Combustion and Flame 2,* 286 286 (1958) Sept. (19 pp.)

Measurements of OH concentrations in flame gases from lean hydrogen-air flames held on porous burners are reported. [OH] is always found to be in excess of equilibrium near the flame and to decay downstream. Decay is formally second order in OH and rate constant is relatively insensitive to pressure, temperature and composition, and has an average value of about $10^{-13}cm^3$/ molecule sec. Effects of addition of small amounts of nitric oxide have been studied. Data are present on relationship between intensity of light emitted from nitric oxide containing nearly stoichiometric flames and [OH], and it is argued that these provide strong evidence that nitric oxide test for 0 atoms is quantitative.

The Flashback of Laminar and Turbulent Burner Flames at Reduced Pressure. B. Fine. *Combustion and Flame 2,* 253 (1958) Sept. (14 pp.)

Effect of reduced pressure on critical boundary velocity gradient for flashback has been studied for laminar and turbulent burner flames of hydrogen and propane with a variety of oxygen-containing mixtures. Proportionality between the boundary velocity gradient and the burning velocity divided by the quenching distance is examined. Detailed examination is difficult because of uncertainties in pressure exponents, particularly for burning velocity. However, flame reaction orders based on flashback are in general agreement with those based on quenching and burning velocity. Comparison of flashback gradients in the turbulent and laminar regions suggests that a turbulent burner flame near flashback is stabilized in the laminar sublayer. This interpretation requires, however, that a flame in a field of pipe turbulence shall penetrate about three times closer to a cold wall than a laminar flame.

Formation of Polycyclic Hydrocarbons in Diffusion Flames. J. R. Arthur, B. T. Commins, J. A. S. Gilbert, A. J. Lindsey and D. H. Napier. *Combustion and Flame 2,* 267 (1958) Sept. (6 pp.)

Polycyclic hydrocarbon content of products from reversed diffusion flames of methane and ethylene and from the pyrolysis of acetylene have been examined; 20 compounds have been identified and determined. A high degree of similarity between the qualitative

compositions of the polycyclic hydrocarbon fractions of the products was found. Experimental evidence is discussed with reference to mechanism of carbon formation in diffusion flames. It is suggested that acetylene may be the precursor of the polycyclic hydrocarbon, but it is shown that pyrolysis alone is not responsible for carbon formation and that oxygen intervenes either in the pyrolytic or in other reactions.

Hydroxyl Concentrations in Rich Hydrogen-Air Flames Held on Porous Burners. W. E. Kaskan. *Combustion and Flame 2,* 229 (1958) Sept. (15 pp.)

Cooled porous metal burners are shown to have great advantages for study of chemical kinetics in flames and flame gases. Method is described for determining quantitatively the concentration of the OH radical in flame gases and measurements are reported for rich hydrogen-air flames. OH concentrations near the flame are shown to be always in considerable excess of calculated equilibrium concentrations.

Infrared Emission Spectra of Flames under High Resolution. E. K. Plyer and E. D. Tidewell. *J. Research 61,* 263 (1958) Oct. (6 pp.)

Spectrum of a hydrogen-oxygen flame and an oxyacetylene flame has been measured in the near infrared region with a high-resolution grating spectrometer. In region from 3.7-4.1 (microns), many lines are observed which have not been classified. They may arise from transitions belonging to the ν_2 or ν_3 bands of water vapor. Intensity of the first overtone bands of CO was increased when a high-frequency discharge was passed through the flame and the infrared CN band was increased in intensity when N_2O was mixed with the acetylene. Results are shown in five figures of observed spectra.

Kinetic Studies of Hydroxyl Radicals in Shock Waves. II. Induction Times in the Hydrogen-Oxygen Reaction. G. L. Schott and J. L. Kinsey. *J. Chem. Phys. 29,* 1177 (1958) Nov. (6 pp.)

Formation of OH in the shock wave induced combustion of H_2 and O_2 has been measured by oscillographically recording the absorption of ultraviolet OH line radiation. Main features of reaction course are: 1) an induction period whose length t_i varies inversely with $[O_2]$; 2) an increase in the product $[O_2]t_i$ as t_i becomes short compared to the vibrational relaxation time of $[O_2]$, and 3) at the end of the induction period a sigmoid rise of OH to a maximum, followed by a slow decrease.

Use of the Constant-Volume Bomb Technique for Measuring Burning Velocity. R. C. Eschenbach and J. T. Agnew. *Combustion and Flame 2,* 273 (1958) Sept. (13 pp.)

Method for computing normal burning velocity, called S_{u_3} from observed data in constant-volume bomb measurements is developed from first principles. Theory accounts approximately for effects due to finite velocity of sound, and shows how radius/time measurements may be used to determine S_u for quite fast-burning mixtures. It is shown that the degree of completeness of combustion, important in computing S_u cannot be determined with any accuracy from bomb data, even with simultaneous pressure and radius measurement. Experimental apparatus suitable for constant-volume bomb work at super-atmospheric initial pressures is described, and measurements of flame speed are reported for a stoichiometric methane-oxygen mixture for pressures from 0.1-2 atmospheres. Values of S_u computed from data on flame speed are in fair agreement with values obtained by burner methods.

Furnaces

Indirect Gas Fired Furnaces for High Temperature Processes. A. H. Koch. *Ind. Heating 25,* 2252 (1958) Nov. (7 pp.)

Metals with improved strength to weight ratio have been developed through new processes generally involving temperatures above 1850°F. Treating materials at these temperatures, although not new to the furnace industry, creates a marked deviation from problems of the past. Today, there are a far greater number of processes requiring higher temperatures. Included are brazing, sintering of powdered metals, heat treatment of stainless steels and carburizing at temperatures of about 1900°F.

Notes on Recirculation Furnaces. W. Trinks. *Ind. Heating 25,* 1970 (1958) Oct. (4 pp.)

Design of recirculating furnaces and calculation of required heating time have led to development of thumb rules based on practice. Each rule holds true within narrow limits, but fails when applied beyond these limits. Rules were devised from practice because no analytical theory exists for recirculating furnaces.

Heat Treating

Exothermic and Purified Exothermic Atmospheres for Sintering Powder Metal Parts. H. M. Webber. *Ind. Heating 25,* 2000 (1958) Oct. (6 pp.)

Production of exothermic and purified exothermic atmospheres for use in sintering of powder metals is explicitly described.

Special Control Method in Continuous Carburizing of Truck Transmission and Rear Axle Gears. H. C. Harris. *Ind. Heating 25,* 1981 (1958) Oct. (7 pp.)

Key to meeting quality specifications lies in carbon potential control of gas carburizing atmosphere. Surface carbon content of the case is definitely a function of carbon potential of furnace atmosphere. Carbon potential is readily measured by dewpoint and dewpoint therefor is used as prime controlling factor in maintaining furnace atmosphere.

Industrial Heating

Close-Control Batch Cooking Improves Synthetic Resin Production. C. F. Silleck. *Ind. Gas 37,* 2 (1958) Nov. (3 pp.)

Problem of combining speed of heating with uniformity of heat application and precision control was solved by a specially designed Gradiation system. Since its installation, production of vehicles in any quantity (from as small as five drum batches up to 45 drum batches) can be handled on any given run. Heat release from a burner cluster can be automatically throttled over a turndown ratio of 15:1.

Efficiency and Economy—Their Effect on Industrial Gas Sales. W. A. Lloyd-Dodd. *Gas World 148,* 872 (1958) Nov. 8 (3 pp.)

Efficiency is considered under three headings: thermal, fuel and national fuel efficiency. Over-all production efficiency is, within the context of the article, a matter of economy rather than efficiency.

LPG

LPG Cuts Fuel Costs for Asphalt Plant. *Construction Methods and Equipment 40,* 85 (1958) Nov. (3 pp.)

Because the Freeto Asphalt Co., Pittsburg, Kansas, operates in an area where butane is readily available and inexpensive, the company cuts its fuel bill by about 33%. But these fuel savings would not apply in other areas of the country where supplies of butane or propane are limited. Freeto, however, discovered other advantages besides lower fuel costs when it converted its model plant to LPG.

Ranges

Gold Star. Special Report. *Gas Age 122,* 41 (1958) Oct. 30 (3 pp.)

Clarification of "Blue Star" and "Gold Star" programs. After Jan. 1, 1959, "Blue Star" Seal of Approval will denote that a gas range complies with American Standard Approval Requirements, including automatic oven-broiler ignition. "Gold Star" is offered as mark for world's finest range. These ranges must comply with ASA Requirements for Domestic Gas Ranges, Z 21.1 or Z 21.2; in addition, these ranges must also comply with all basic specifications listed in article.

Refrigerants

Refrigerants. W. A. Pennington. *Air Conditioning, Heating and Ventilating 55,* 71 (1958) Nov. (16 pp.)

Although a refrigerant is basic element of a refrigeration system, not too many engineers have a clear understanding of the various refrigerants commonly used, how one differs from the other, desirable properties in refrigerants and refrigerant mixtues. Article includes pertinent information that should be valuable to engineer engaged in air conditioning and refrigeration work.

Refrigeration

Cooling Systems Based on Solar Regeneration. D. A. Williams, R. Chung G. O. G. Lof, D. A. Fester and J. A. Duffie. *Refrigerating Eng. 66,* 33 (1958) Nov. (7 pp.)

Intermittent adsorption or absorption refrigeration cycles, with regeneration by heating with solar energy, have been proposed for small food coolers and space cooling in non-industrialized areas where refrigeration is not available for economic or technological reasons and where solar radiation is ample and reasonably dependable. Study of food coolers provided certain performance data for discussion: evaluation of potentially useful binary absorption systems; how operating variables affect ideal thermal performance of refrigerant-absorbent systems; illustrative experimental data on solar operation of two intermittent refrigeration systems; and analysis of experimental results of solar regeneration process as it affects refrigeration capacity.

An Improved Absorption Refrigeration Cycle. E. P. Whitlow and J. S. Swearingen. *Gas Age 122,* 19 (1958) Oct. 30 (4 pp.)

Presentation of new absorption refrigeration system developed by Southwest Research Institute as result of a two-year research program sponsored by the A. G. A. New system, as compared to other similar absorption systems previously developed, shows a 50% improvement in the coefficient of performance, a 30% reduction in fuel consumption and a 25% reduction in cooling water requirements. Engineering aspects of these improvements are discussed; charts and flow sheets are given.

Space Heaters

Gas Heavy-Duty Forced Air Heaters Are Favored for Varied Uses. *Ind. Gas 37,* 5 (1958) Nov. (4 pp.)

Increasing attention to heating and ventilating problems, modernization of plants as well as new structures, emphasis on ample space to avoid crowding, and economy in operation are among advances cited

as causing trend to installation of gas heavy duty forced air heaters.

Heating of Palace VII (Palace of Arts) at the 1958 Bruxelles Exposition. M. Brabant. *Rev. Gen. du Gaz 80,* 191 (1958) Sept.-Oct. (8 pp. French text.)
Description of the building, warm-air heating system, circulating and ventilating system, air-heating furnaces and gas-fired radiators is given. This large exhibition hall of 5.3 million cu. ft volume is heated entirely by city gas fuel, requiring less than 60,000 CF/hr.

How to Heat the *Useful* Space. J. W. Adams. *Gas Heat and Comfort Cooling 9,* 34 (1958) Oct. (2 pp.)
Case history of application of infrared heating during conversion of 20-year old iron foundry building into a modern discount department store.

Panel Sorts Thermostat Demands. G. T. Hastings. *Gas Heat and Comfort Cooling 9,* 36 (1958) Nov. (6 pp.)
Discussion of Detroit CA-353 Universal Control Panel which represents an effort to develop and manufacture a central panel to which can be connected all controls needed by almost any domestic or small commercial year-round system which uses a compressor motor up to 3 hp size.

Pulsations in Single-Port Gas-Fired Residential Heating Equipment. C. F. Speich and A. A. Putnam. *Heating, Piping & Air Conditioning 30,* 139 (1958) Nov. (8 pp.)
Mechanism of oscillations for single-port gas units was found to consist of a vortex-shedding phenomenon at the burner lip coupled with a pressure fluctuation in the heating unit. Natural frequency of the vortex shedding was found to be a function of the average velocity of the combustible gas stream, whereas the frequency of the pressure fluctuations in the heating unit is determined by resonant frequency of the furnace or boiler. It is the degree of the coupling between these two frequencies when they are together which determines the amplitude of oscillation. Applying the knowledge of details of the driving mechanism, it is possible to devise more basic means of suppressing oscillations in these units.

Space Heating

Control of Radiation for Steam and Hot Water Heating. L. Smith. *Air Conditioning, Heating and Ventilating 55,* 83 (1958) Dec. (3 pp.)
When designing a control system for steam or hot water radiation, a decision on central control must be made first. Only then can the engineer consider such modifications or additions as may be needed to accommodate local conditions.

Fuel Oil: What Every Heating Engineer Should Know. W. Hammer. *Heating, Piping and Air Conditioning 30,* 112 (1958) Dec. (7 pp.)
Questions and answers on fundamentals of fuel oil are presented—including what it is, its composition, its economic aspects, its heating values, how its various grades are best used, how to find its specific gravity and API gravity and what they mean, importance of viscosity on successful combustion and how it is measured, and many other basic facts.

Modern Gas Heating Installation Service. (New York: *Gas Heat and Comfort Cooling,* 1958.)
Compendium of "best articles published in the past year" contains 34 items grouped under subject headings of gas burner installation, gas combustion, gas burner service, gas burner venting, power gas burners and special gas burner applications.

Research on Heating and Ventilation in Relation to Human Comfort. *Heating, Piping and Air Conditioning 30,* 127 (1958) Dec. (8 pp.)
Skin temperature has been used as an objective index of comfort, but various studies have shown that it is of dubious value for that purpose. It is not enough merely to insure that effective temperature is suitable. Various other factors contribute to pleasantness of environment. There should be adequate but not excessive air movement, and a suitable humidity. Cold walls make for discomfort, as do also excessive vertical gradients of air temperature. In a room heated by ceiling panels, the elevation of MRT due to the panels should not exceed 4°F. When floor heating is used, surface temperature of floor must not be excessive; according to recent experiments, it should not be above 77°F.

Ventilation

Eight Rules for Good Practice in Venting Gas Heating Appliances. W. M. Myler, Jr. *Gas Age 122,* 25 (1958) Nov. 27 (5 pp.)
Construction changes in new building and modernization of existing structures has created need for closer look at venting methods. Discussion of good installation practice and listing of seven unsuccessful venting practices under which venting failures could commonly be classified. Latter discussion is based on research conducted by Purdue University.

Water Heaters

Relief Valves: How and Why. F. Lowe. *Gas Heat and Comfort Cooling 9,* 35 (1958) Oct. (4 pp.)
Absence of a relief valve on gas water heater or hot water heating system is attributable only to carelessness. Improper application is as bad. Trade's leading authority offers refresher article.

Industrial Heating

Continuous Metal Melting. F. O. Hess (assigned to Selas Corp. of America) U. S. 2,857,642 (1958) Oct. 28.

Metal is melted by moving solid metal continuously into a melting zone from which it drains from the sloped earth by stoppered spouts to one or other of two pots in a holding furnace. the melted metal being treated or filled into one pot while that in the other is being withdrawn and used.

Ore Reduction

Apparatus for Reducing Ores. D. F. Dickey (assigned to Electrolyser Corp., Ltd.) U. S. 2,857,155 (1958) Oct. 21.

Vertical reactor for reducing iron ore consists of a central porous alundum tube carrying an electrical coil for heating and a bottom gas inlet for hydrogen. This capped tube is placed within a similar larger diameter tube to form an annular space through which fine ore flows downward while hydrogen flows transversely through the porous walls, spent hydrogen being collected in an over-all gas-tight housing and purified and recirculated while reduced iron is removed by a gas-locked conveyor.

Refrigeration

Absorption Refrigeration Apparatus. W. C. Smith and H. F. Mason (assigned to Worthington Corp.) U. S. 2,855,765 (1958) Oct. 14.

Absorption refrigeration system is claimed including a shell with an inclined partition which divides it into an upper condenser section and a lower evaporation section. An orifice is located in the lower edge of said partition through which condensed refrigerant flows depending on head of liquid above partition, an air coil forming the cooling equipment and means for circulating refrigerant from evaporator through cooling equipment and back to condenser.

Space Heating

Baffle System in Space or Wall Heater. C. L. Ruhl. U. S. 2,859,742 (1958) Nov. 11.

Improved baffle system for a circulating, gas-fired wall-type heater is claimed in which obliquely placed baffles for directing warm air past the radiant element form an assembly which is mounted in an inner casing spaced away from the shell. The top of this casing also is bent outward and downward like the baffles so that all rising warm air is directed outward into the room and the outer shell is cooled by the outermost stream.

10. EQUIPMENT AND INSTRUMENTATION

Automation

Automation in the Research Laboratory. C. M. Maddin and R. B. Rosene. *World Petrol. 29,* 64 (1958) Nov. (4 pp.)

Using an instrument or machine to solve a problem or perform a task, whether in the laboratory or factory, can be justified only on the basis of improved performance. Its use should result in doing a job faster, with fewer workers or at a lower cost, particularly when time is of prime importance. Article gives examples to demonstrate where use of instruments has aided in these three respects.

Control Engineers Must Learn How to Spot Opportunities. B. K. Ledgerwood. *Control Eng. 5,* 68 (1958) Dec. (10 pp.)

Control engineer must also be accountant and economist if he is to determine where economic gain through improved performance, cost savings and increased process earnings will justify additional capital expenditure for measurement and control equipment.

Electronic Process Control Systems. H. R. Karp. *Control Eng. 5,* 81 (1958) Nov. (16 pp.)

Each electronic control system, regardless of inherent differences, performs four common functions: 1) measures process variable and transduces it to an electrical signal for transmission; 2) compares transmitted electrical signal with desired value of process variable to develop an error signal; 3) characterizes error signal, through proportional, reset and rate actions in a controller, into a controller output appropriate to process dynamics; 4) converts controller's electrical output signal into a corresponding stem position of an electrically signaled actuator. Report starts with three questions asked of a user, a contractor and the makers of new electronic systems. Basics of electronic control systems follow. Actuator also is covered, along with highlights of the six control systems.

Computers

Analog Computing in the Chemical and Petroleum Industries. T. J. Williams. *Ind. Eng. Chem. 50,* 1631 (1958) Nov. (5 pp.)

Electronic differential analyzer type of analog computer is now by far the most common type in use today. Having been a vital tool of the defense industries almost from its inception in the late 1940's, it is now becoming an equally important tool of the chemist and chemical engineer as well. Report traces some background and history and application of these machines, especially as related to the chemical

and petroleum industries. Present applicability of analogs is defined in relation to other available means of computation, and the areas where their use holds the most promise are specified.

Electronic Data Processing and Management in the Chemical and Petroleum Industry. J. W. Redding. *Ind. Eng. Chem. 50,* 1622 (1958) Nov. (2 pp.)

Although there is a general impression that the businessman soon will be able to predict the future and solve his management problems by using electronic data processing machines, these machines cannot change the usual business system of gathering information, evaluating it, and acting upon it. Machine is only an efficient link in information flow. However, electronic data processing will strengthen management's control by providing means for more systematic evaluation of co.nplex operating problems.

An Electronic Computer as a Research Assistant. W. J. Waldo and E. H. Barnett. *Ind. Eng. Chem. 50,* 1641 (1958) Nov. (3 pp.)

Machines are available today to perform repetitive calculations, to write much of the routine for reports and to find meaning in the large mass of data this technological age is generating. Use of computers to assist researcher can make most research organizations accomplish more per scientist, can relieve these scientists of many routine chores, and as a bonus can be offered for use in solving accounting problems when there is spare time from scientific work.

Computers as Tools for Synthesis, Experimentation and Information Handling. W. Orchard-Hays. *Ind. Eng. Chem. 50,* 1654 (1958) Nov. (3 pp.)

Problems which computer people encounter are difficult, novel and challenging. There is a growing awareness both of the potential uses of data processing systems and of the contributions to knowledge made during the necessary analysis and formulation of methods for their use.

Multicomponent Distillation Calculation on the IBM 704. J. Greenstadt, Y. Bard and B. Morse. *Ind. Eng. Chem. 50,* 1644 (1958) Nov. (4 pp.)

Method for solving multicomponent distillation problems has been developed and programmed for a high speed digital computer (IBM 704). Newton root-finding method is used for both individual tray and over-all column balance. Method permits application of a wide variety of product, feed and side stream specifications. It also permits application of any thermodynamic correlations desired, including the Benedict-Webb-Rubin equations of state—which also have been programmed.

From Programmer to Computer. G. M. Hopper. *Ind. Eng. Chem. 50,* 1661 (1958) Nov.

It is becoming possible to replace the coder, who translates the problem into specific instructions, by the computer itself. Natural language pseudo-codes and their compiling systems are of particular value to scientists. Automatic master routines that will tailor a computer to the pseudo-code desired by the user are now feasible. They should be achieved within five years.

Fractionation

Discharge Coefficients Through Perforated Plates at Reynolds Numbers of 400 to 3,000. P. L. Smith, Jr. and M. Van Winkle. *A. I. Ch. E. J. 4,* 266 (1958) Sept. (3 pp.)

The correlation of Kolodzie and Van Winkle (3) for predicting dry plate orifice coefficients through perforated plates originally covering a Reynolds number range of 2000 to 20,000 has been extended to apply to Reynolds numbers as low as 400. The correlation applies to column diameters ranging from 3 to 15 in.

Versatile Fractionating Column for the Laboratory and Pilot Plant. H. S. Myers. *Ind. Eng. Chem. 50,* 1671 (1958) Nov. (4 pp.)

Fractionating columns are used in many kinds of applications. A single column that could be readily adapted for any type of service was desired. Columns developed for this purpose appear to have real merit for laboratory and pilot plant work. Trays are removable and can readily be modified to nearly any requirements. Cleaning is simple. Capacity is about three or four times that of conventional laboratory columns. Pressure drop is low and the efficiency curve is flat, particularly at the wider tray spacings. Columns of this type should find a definite place in the laboratory and pilot plant.

Heat Exchangers

Air Cooled Heat Exchangers. E. C. Smith. *Chem. Eng. 65,* 145 (1958) Nov. 17 (6 pp.)

Direct cooling of fluids by passing ambient air over extended (finned) tube surfaces is a comparatively recent innovation. Its application has been cautiously adopted because of the usual reluctance to change from conventional methods, and because of the lack of available publications which provide information to potential users for rating and estimating air-cooled exchangers. Article should serve as a guide for determining approximate surface, operating power, plan area, weight and price information for air-cooled heat exchanger applications.

How to Inspect and Maintain Fired Heaters. P. von Wiesenthal. *Oil Gas J. 56,* 103 (1958) Dec. 1 (9 pp.)

Inspection of fired heaters must be designed primarily to assure safe operation at all times. This requires implementation of a program consisting of four basic steps: 1) regular inspection during operation; 2) elimination of potentially dangerous operating conditions; 3) a regularly scheduled shutdown and detailed mechanical inspection, and 4) repair or replacement of all components that do not meet rigid minimum standards.

Process Design

Selecting Motors and Motor Controls. C. R. Olson. *Petrol. Refiner 37,* 91 (1958) Oct. (13 pp.)

Curves showing how to get motor prices in relation to horsepower, speed, type of enclosure, type of motor and voltages are included in this article which deals with squirrel-cage and synchronous motors. Trends in motor usage as affected by the API Code RP500 and by recent design changes are discussed. Motor sizes from 1-20,000 hp are covered.

What You Ought to Know About Process Flow Sheets. D. J. Oriolo. *Oil Gas J. 56,* 151 (1958) Nov. 17 (4 pp.)

Article provides basis for better understanding between designer who must prepare flow sheets and operator who must use them. Tabulation of equipment symbols, an example of which is included, should insure more uniform flow sheets. Preparation of the process flow sheet is first major step in overall design of process facilities. It must present process accurately and clearly.

Reactors

An Improved Experimental Reactor for Applied Kinetic Studies. T. K. Perkins and H. F. Rase. *J.A.I.Ch.E. 4,* 351 (1958) Sept. (5 pp.)

Recirculation type of reactor has been designed and tested on a rapid reaction which characteristically causes difficult temperature-control problems and high diffusional resistances (hydrogenation of propylene on nickel catalyst). Descriptions of reactor and its operation are given together with an assessment of errors and advantages and disadvantages of recirculation technique. Rate equation and rate constants are determined so that the data will be more readily comparable with work of other investigators.

Temperature Measurement

Recent Advances in Transient Surface Temperature Thermometry. J. G. Hall and A. Hertzberg. *Jet Propulsion 28,* 719 (1958) Nov. (5 pp.)

Review of some advances in transient surface temperature thermometry and calorimetry of the past five years in the field of shock tube and shock tunnel heat transfer research. Two basic techniques successfully evolved for shock tube heat transfer measurement are thin film surface thermometry and thick film surface calorimetry. Former method records instantaneous suface temperature from which instantaneous heat transfer rate is calculated. Latter method records total heat input at the surface and instantaneous heat transfer rate is given by the corresponding time rate of change.

Accuracy of Optical Pyrometry in the Range 800°C to 4000°C. D. R. Lovejoy. *Can. J. Phys. 36,* 1397 (1958) Oct. (12 pp.)

Pair of secondary standard tungsten strip lamps have had a luminance temperature-current calibration in the range 800°C-2200°C, in laboratories. Analysis of results confirms estimates of the accuracy of optical pyrometry in the range and supports extension of these estimates to 4000°C. Standard deviation uncertainty of optical pyrometry is shown to be about 1°C at 800°, rising to 2°C at 2200°C and 10°C at 4000°Cm being about double this for calibration of commercial pyrometers unless certain described precautions are taken.

Valves

Gas Valves. C. C. Lamar (assigned to Harper-Wyman Co.) U. S. 2,858,852 (1958) Nov. 4.

Valve is claimed with valve-plug bored for supplying gas to main and simmer sections of a double burner, and of high and low quantities of gas to only the simmer section, by means of bores in several angular positions which open into a chamber beyond the plug.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Cathodic Protection

Cathodic Protection of a Gas Distribution System. E. F. Fowler. *Corrosion 14,* 533t (1958) Nov. (6 pp.)

Manner in which a gas company applied cathodic protection to its gas distribution system is described. Topics discussed include setting up a basis for current requirements, analyzing of cathodic protection work orders, engineering of cathodic protection for new installations, protection of replacements of pipe, and cathodic protection of a town as a unit. Coordination of work done between various sections of the company in applying cathodic protection are outlined.

Deep Groundbeds for Line Protection. R. L. Bullock. *Pipe Line Ind. 9,* 40 (1958) Oct. (5 pp.); *Oil Gas J. 56,* 94 (1958) Dec. 8 (5 pp.)

Deep steel groundbeds, while successful, have a short life expectancy and make maintenance of cathodic protection costly. Development of a deep graphite coke-breeze backfill groundbed with a life expectancy of 20 or more years has removed this disadvantage. Installing a steel casing makes it possible to provide the anode string with proper backfill. Steel casing serves as the anode until it disintegrates leaving the graphite rods and backfill to continue as the anode.

Locating Underground Contacts and Open Couplings by Electrical Measurements. C. L. Woody. *Corrosion 14,* 505t (1958) Nov. (8 pp.)

Article gives practical approach to problem of locating couplings and open contacts on underground electrical circuit. While some of the methods used may not be entirely correct from a theoretical standpoint, in application they have resulted in a satisfactory solution to underground open couplings and contact problems. Equipment discussed includes the ammeter, volt meter, pipe locator, current interrupter, and other readily available variations of these instruments. Discussion deals primarily with practical use, limitations, and results that may be obtained by trained and experienced personnel. Emphasis is placed on experience and interpretation of results observed rather than on a theoretical approach.

Use Pipe-to-Soil Graphs Effectively. J. Emery. *Am. Gas J. 185,* 40 (1958) Nov. (3 pp.)

Pipe-to-soil graphs are one of the most valuable aids in obtaining a quick over-all picture of the existing situation when applying cathodic protection to existing gas distribution systems. Graphs of pipe-to-soil readings plotted against miles of line serve to illustrate 12 typical graphic tools for use by corrosion control personnel.

Coatings

New England Utility Adopts Plastic-Coated Steel Pipe. *Gas 34,* 50 (1958) Dec. (3 pp.)

Changing soil conditions caused Lynn Gas & Electric Co. (Mass.) to begin a system-wide policy of corrosion prevention. Plastic-coated steel pipe has been chosen. This pipe, available in sizes up to 4.5 in. O.D. is factory-coated with an extrusion of polyethylene of thicknesses ranging upward from 0.025-in. applied over a live elastic, adhesive undercoating of 0.005-in. thickness. Material was a high insulation resistance (500,000 megohms) and dielectric strength (25,000 v). Moisture absorption is only 0.01%.

Corrosion

API Survey Shows Few Amine Corrosion Problems. *Petrol. Refiner 37,* 281 (1958) Nov.

Use of alloy materials in reboiler bundle has effectively eliminated main corrosion problem in amine stripping system.

Controlling Corrosion of Offshore Platforms and Some Typical Costs on a Tender-Type Installation. *Corrosion 14,* 93 (1958) Nov. (3 pp.)

After considering in general problem of protecting an offshore platform in sea water, some suggestions are given concerning proper design. Successful vinyl painting system is described and recommendations are made concerning specifications, inspection during and after initial painting. Methods used to protect old equipment are listed, and data are given on an example of 5-year corrosion control costs on an offshore rig.

Corrosion-Resistant Experimental Steels for Marine Applications. C. P. Larrabee. *Corrosion 14,* 501t (1958) Nov. (4 pp.)

Six steels having various combinations of nickel, copper and phosphorus were tested in sea water for exposure periods of one, two and five years, and a comparison made with the corrosion resistance of structural carbon steel. Test specimens measured 20 ft in length and were placed in sea water so that their tops extended above the splash zone while the bottoms were in the mud. Decreases in thickness were calculated at 20 different levels for each of the Ni-Cu-P steels. It was found that these steels as a class were much more corrosion resistant than the sheet-piling steel to the conditions existing in and above high tide. Superiority was even greater when steels were exposed to atmosphere 80 ft from shore.

The Electrochemical Behavior of Aluminum. E. Deltombe and M. Pourbaix. *Corrosion 14,* 496t (1958) Nov. (5 pp.)

Study was conducted of electrochemical behavior of aluminum in presence of aqueous solutions. Potential *p*H equilibrium diagram of the system aluminum-water at 25°C was developed from standard free energies of constituents, and general electrochemical behavior of aluminum was deduced from the diagram. Diagram indicates theoretical circumstances under which aluminum should show corrosion, immunity and passivity, under the hypothesis that passivation results from formation of a film oxide whose stability resembles that of hydragillite. Stability of aluminum and different forms of its oxides are discussed. Curves are given of solubilities of oxides and hydroxides as functions of *p*H.

How to Avoid Piping Corrosion in Nuclear Reactor Plants. W. Z. Friend. *Heating, Piping & Air Conditioning 30,* 105 (1958) Dec. (4 pp.)

Success of nuclear reactor plants depends, to a great extent, on how well its component piping can resist corrosion at high operating temperatures This can be accomplished by specifying correct corrosion resistant materials after careful analysis of precise operating conditions to be met. Article discusses various methods for designing piping for pressurized water reactors.

How to Detect and Control Corrosion-Causing Bacteria. C. H. Oppenheimer. *World Oil 147,* 144 (1958) Dec. (4 pp.)

Combatting bacterial corrosion requires an understanding of the processes involved and methods that restrain it. Some aspects of this type of corrosion are not completely understood, but known methods discussed will aid in corrosion control.

Influence of Metallurgical Variables on Resistance of Steels to Sulfide Corrosion Cracking. J. P. Fraser and G. G. Eldredge. *Corrosion 14,* 524t (1958) Nov. (7 pp.)

Statistical study of sulfide corrosion cracking of steel as a function of chemical composition, mechanical properties and heat treatment. Total of 104 different alloys were studies, of which 79 were commercially produced API grades J-55, N-80 and P-110 steels. It was possible to derive predictive equations which can be used to rate crack susceptibility of a new alloy from its known metallurgical properties. Resistance to cracking is increased most rapidly by increases in ductility and in carbon content. Resistance to cracking is decreased most rapidly by increases in hardness, strength and manganese and molybdenum content. An additional result of investigation is demonstration that resistance to cracking can be markedly improved by tempering N-80 steel for one-half hour at 1100°F. Accompanying loss of yield strength is not excessive.

Plastics

Nylon 6 for Process Applications: Tougher, Stronger than Usual Nylons. D. L. Duncan. *Chem. Eng. 65,* 130 (1958) Dec. 1 (3 pp.)

Active newcomer to nylon family is Type 6, which is polymerized from caprolactam, a material having a single six carbon ring. There are, in addition, other types of nylon available such as Type 610, Type 11, and various copolymers, each of which carries a designation based on the carbon atom arrangements. Stronger and more resistant than usual nylons. Type 6 soon will be available as pipe and fittings for corrosive process applications.

Peoples Gas Utilizes Plastic Tubing for Gas Service Pipes. *Gas Age 122,* 17 (1958) Nov. 27 (3 pp.)

In less than five years, Peoples Gas (Chicago) has used more than 200 miles of plastic tubing to replace approximately 23,000 steel services. During the last two years plastic has been used for 75% of all service replacements by the company. Steel piping, however, still is used almost exclusively for original service connection to domestic customer's home.

Welding

Welded Repairs on API 5LX52 Pipe. R. D. Morel. *Gas 34,* 99 (1958) Dec. (6 pp.)

Large volume of research currently being conducted has for its purpose evaluation and improvement of specifications for materials, welding procedures, manufacturing procedures, construction procedures, etc., for high-test line pipe. Article specifically deals with recent tests of welded repairs made on 5LX52 cold-expanded line pipe. Problem as why a crack, once initiated, would sometimes travel through several hundred feet of pipe in a failure was investigated under A.G.A. sponsorship and results of this investigation have defined within reason conditions under which this type of failure is likely to occur.

Thermal Insulation

Collapsible Insulation. W. L. Morrison (assigned to The Union Stock Yard and Transit Co. of Chicago.) U. S. 2,859,489 (1958) Nov. 11.

Collapsible insulation of light density is claimed, which comprises a multiplicity of flexible sheets each faced with adhering fibrous insulating material, each sheet held parallel to the next by many flexible threads. The whole assembly is faced by two stiff coverplates, also cemented to the threads, to permit suspension of the unit with limited separation of sheets, or compaction when in storage.

12. ANALYTICAL METHODS AND TESTS

Air Pollution

Fractional Sublimation Technique for Separating Atmospheric Pollutants. J. F. Thomas, E. N. Sanborn, M. Mukai and B. D. Tebbens. *Anal. Chem. 30,* 1954 (1958) Dec. (5 pp.)

Fractional sublimation technique is developed for separating large quantities of particulate organic material from polluted air. Technique renders quantitative separation for synthetic mixtures of polynuclear hydrocarbons but in application to atmospheric samples resinous interference is encountered.

Analytical Instruments

A Differential Thermal Analysis Apparatus. F. W. Wilburn. *J. Sci. Instruments 35,* 403 (1958) Nov. (5 pp.)

Automatic differential thermal analysis apparatus of high sensitivity is described in detail. Rate of heating is servo-controlled to give any selected value from 6-20°C/min. Curves are obtained directly on an X-Y potentiometric recorder. Temperature differences can be detected to within 0.1°C. Reference is made to application of the apparatus in the study of glass-making reactions.

Gas Circulating Apparatus Containing a Magnetic Balance. L. C. Scala, W. M. Hickam and A. Langer. *Rev. Sci. Instruments 29,* 988 (1958) Nov. (3 pp.)

Gas circulating system is described in which a sample undergoing thermal decomposition can be weighed continuously by means of a magnetic balance having a sensitivity of the order of 0.1 mg. Changes of composition in the gases contained in the system are determined by withdrawing samples directly into a mass spectrometer process are thus obtained, providing an insight into the reactions that occur. Simple system should prove useful in many other fields of investigation.

Carbon

The Determination of Carbon and Hydrogen in Coal and Coke by the Liebig Method: Elimination due to the Formation of Nitrogen Dioxide. M. P. Mendoza. *Fuel 37,* 409 (1958) Oct. (6 pp.)

Probable errors in both carbon and hydrogen values for coal and coke determined by the B. S. Liebig method due to nitrogen dioxide absorption have been assessed. Better carbon values may be obtained by absorbing the oxides of nitrogen in granular manganese dioxide. An empirical correction for hydrogen is suggested.

Evolution of Oxides of Nitrogen and of Sulphur during the Determination of Carbon and Hydrogen in Coal. A. H. Edwards. *Fuel 37,* 415 (1958) Oct. (6 pp.)

Description of investigation into evolution of oxides of nitrogen and sulfur in the Liebig method for the determination of carbon and hydrogen in coal. It is demonstrated that oxides of sulfur produced during combustion are completely absorbed in a properly packed Liebig tube and that oxides of nitrogen are evolved in quantities sufficient, unless removed, to cause an error of approximately 0.2% in the carbon determination. Effectiveness of manganese dioxide in removing these oxides of nitrogen is confirmed. It is shown that only traces of oxides of nitrogen are evolved in the Sheffield High Temperature method.

Chromatography

Gas-Liquid Partition Chromatography. Determination of 2,6-Di-*tert*-butyl-p-cresol on Antioxidant-Treated Paperboard. E. C. Jennings, Jr., T. D. Curran and D. G. Edwards. *Anal. Chem. 30,* 1946 (1958) Dec. (3 pp.)

Antioxidant, 2,6di-*tert*-butyl-*p*-cresol, content of treated paperboard is determined by extraction with cyclohexane-isopropyl alcohol and concentration prior to gas-liquid partition chromatography. Over a concentration range of 14.4 to 144 mg/sq ft recoveries of 100± 10% were obtained. Retention time may be used for identification of antioxidants and masking compounds.

How Phillips Applies Chromatography. J. A. Favre, W. J. Hines and D. E. Smith. *Petrol. Refiner 37,* 251 (1958) Nov. (4 pp.)

Phillips has discovered gas chromatography to be a rapid, accurate method for analyzing inlet and residue gases at natural gasoline plants. Equipment is relatively inexpensive, easy to maintain and can be used for other hydrocarbon analysis. Report indicates application of chromatographic techniques to complete analysis of natural gas. Details of the apparatus, procedures and typical chromatograms are included.

Separation of Saturated Hydrocarbons from Petroleum Residues. R. D. Schwartz and D. J. Brasseaux. *Anal. Chem. 30,* 1999 (1958) Dec. (4 pp.)

Saturated hydrocarbons are separated from crude oil residues by absorption chromatography. Residue is dissolved in cyclohexane and applied to a column containing two grades of silica gel. Saturated hydrocarbons are eluted with cyclohexane; asphaltenes and resins are absorbed.

Halogens

Determination of Soluble Chloride in Coal Carbonization Products by Water-Methyl Isobutyl Ketone Extraction. L. Ginsburg and L. C. Pasztor. *Anal. Chem. 30,* 2039 (1958) Dec. (2 pp.)

Chloride content of crude tar acids, tar acid oil, and tar feed is determined by water extraction from methyl isobutyl ketone. Chloride then is titrated by the Mohr method. Inorganic interferences are removed by precipitation with copper nitrate.

Hydrogen Sulfide

Maintenance of a Constant Known Partial Pressure of Hydrogen Sulphide in an Enclosed Sphere. E. Hoffman. *Chem. and Ind.* 1507 (1958) Nov. 15 (3 pp.)

Simple procedure for producing an atmosphere containing small quantities of hydrogen sulfide is by use

of solutions of hydrogen sulfide and sodium hydroxide. Concentration of free hydrogen sulfide in such solutions can be calculated from the known dissociation constants of hydrogen sulfide, and from this the concentration of hydrogen sulfide in the atmosphere above such a solution can be derived by applying Henry's Law.

Metals

Microanalysis for Vanadium in Fuel Products. Part 1. Incineration. G. Milazzo, C. Verga and N. Marilli. *Rivista dei Combustibili 12,* 684 (1958) Sept. (6 pp. Italian text); **Part 2. Spectrophotometric Method.** G. Milazzo, F. Spinelli, M. Troyli and C. Verga. *Ibid.,* 690 (1958) Sept. (9 pp. Italian text.)

Inadequacy of classical ashing methods for analysis of trace-elements, especially vanadium, is briefly discussed in Part 1. Much shorter ashing procedure, by combustion with oxygen under pressure in a Mahler-type bomb with suitable modification to avoid contamination of ashes by elements from bomb wall, and its results in analysis of vanadium and in completeness of ashing then is presented. Part 2 critically reviews known methods for spectrophotometric determination of microgram quantities of vanadium. Experimental procedures and results are given for a new spectrophotometric method of determining vanadium in ashes from petroleum products, using *o*-dianisidine, or *o*-tolidine or benzidine as analytical reagent. Method is simple, rapid and practically free from interference by other metals.

Nitrogen

Estimation of Types of Nitrogen Compounds in Shale-Oil Gas Oil. G. U. Dinneen, G. L. Cook and H. B. Jensen. *Anal. Chem. 30,* 2026 (1958) Dec. (5 pp.)

Scheme of analysis is devised for separating and characterizing the types of nitrogen compounds in shale-oil gas oil. Molecular distillation and thermal diffusion techniques are employed for separation and the compounds identified by spectrophotometric, chemical and physical analyses. Pyridines, dihydropyridines, indoles and quinolines are the principal compounds.

Radioactivity Applications

The Application of Radioactive Tracers to Secondary Recovery. J. C. Dempsey, R. E. Finney and R. M. MacFarlane. *Producers Monthly 22,* 24 (1958) Oct. (5 pp.)

Particulate type tracer survey method has been refined to yield quantitative input profile data. Theory and practical application of method are discussed and field results obtained under various conditions are shown. Density matching tracer medium to particular flood water is shown to be essential for obtaining quantitative results. Permanent fixation of the radioisotope in the tracer medium also is necessary. Limitations of method are discussed together with techniques and special equipment employed to minimize these undesirable features.

Sulfur

Studies in Bomb Calorimetry IX—Formation of Sulphuric Acid. R. A. Mott and C. Parker. *Fuel 37,* 371 (1958) Oct. (11 pp.)

It has been determined that sulfur trioxide formed during combustion of a solid fuel dissolves to a negligible extent in the water added to the bomb before a determination of calorific value, 85% of the sulfur in coal and 95% of the sulfur in coke being found in the water released or produced during combustion of the fuel and deposited as fine droplets on the walls and cap of the bomb. Concentration of sulfuric acid in such droplets increases with increase in the sulfur content of the fuel and with decrease in its hydrogen and moisture contents. It is advised that the bomb should be washed out as soon as possible after the determination. For cokes of high sulfur (over 1.75%) and low hydrogen contents, the addition of 0.05g water to the sample is advised. Some of the sulfur trioxide reacts with the alumina pad which is used for coke and some remains in the gaseous phase.

X-Ray Determination of Sulfur in Oils. Comparison of X-Ray Emission and Absorption Methods. W. R. Doughman, A. P. Sullivan and R. C. Hirt. *Anal. Chem. 30,* 1924 (1958) Dec. (2 pp.)

X-ray spectrograph method for determining sulfur in petroleum products is compared with the iron-55 *K*-capture X-ray absorption procedure. Both have nearly the same accuracy; the emission method has greater freedom from interference while the absorption method is less costly.

Viscosity

A Rotational Viscometer Employing a Reference Liquid. J. F. Hills. *J. Sci. Instruments 35,* 415 (1958) Nov. (4 pp.)

Viscometer described is rotational one in which a free rotor is accelerated by the torque transmitted through a reference liquid by a driven rotor, and retarded by the torque acting through the liquid under test which is restrained by a stator. Free rotor thus attains an equilibrium speed of rotation. Ratio of the rates of rotation of the driven and free rotors is a linear function of the viscosity being measured, and, apart from a negligible effect of bearing friction, is independent of the absolute rotational speed of the

driven rotor when using Newtionian liquids. Theory of the viscometer is given together with an account of an experimental verification.

X-Ray Methods

Soft X-Ray Spectroscopy Using an Electron Multiplier. J. A. Catterall, L. F. Wilson and J. Trotter. *J. Sci. Instruments 35,* 393 (1958) Nov. (3 pp.)

Modification to a soft X-ray spectrography in order to use an electron multiplier instead of a photographic plate is described. Instrument has been calibrated with the aluminum and magnesium L_{23} spectra.

13. BASIC SCIENCE

Adsorption

Nuclear Magnetic Resonance Relaxation Studies of Adsorbed Water on Silica Gel. III. J. R. Zimmerman and J. A. Lasater. *J. Phys. Chem. 62,* 1157 (1958) Oct. (7 pp.)

Refined experimental investigation of nuclear magnetic resonance relaxation phenomena of water vapor absorbed on silica gel is described. Two phase behavior for both longitudinal and transverse relaxation measurements is observed to exist simultaneously. The two adsorbed phases in longitudinal relaxation data are shown to be identical with corresponding two phases in transverse relaxation data. Adsorption at low coverage is identified with only the short time relaxation (T_2) component; coverage at which second adsorbed phase begins can be determined. Accurate value for average lifetime of a hydrogen nucleus in an adsorbed phase for a particular coverage is determined. Minimum value of T_1 is established; reasonable values of nuclear correlation times are obtained. New and possibly accurate method for determining the monolayer is discussed.

Chemisorption

Properties of Hydrogen Chemisorbed on Tungsten. J. Eisinger. *J. Chem. Phys. 29,* 1154 (1958) Nov. (7 pp.)

Sticking probability of hydrogen on a single crystal tungsten ribbon was measured as a function of the number of adsorbed atoms. Work function of the same ribbon was measured by a photoelectric technique. Results indicate that during initial fast chemisorption characterized by an almost constant sticking probability of approximately 0.2, the work function rose from 4.54 ev for the clean surface to a maximum value of 5.0 ev for the covered surface.

Diffusion

Diffusion in a Pore of Varying Cross Section. E. E. Petersen. *J.A.I.Ch.E. 4,* 343 (1958) Sept. (3 pp.)

Work discussed deals with quantitative effect of periodic pore constrictions on effective diffusivity. Pore model assumed for study is a hyperbola of revolution giving a pore constriction at the vertex of the hyperbola. Solutions to the steady state diffusion equation in a pore of this shape were obtained at various values of β, the ratio of the maximum to the minimum cross section in the pore. Comparison of the rate of diffusive transport in this pore and an equivalent cylindrical pore indicates that δ, the ratio of the effective to the normal diffusivity, is about 0.33 at $\beta = 25$ for large pores. At the same value of β, δ would be smaller for diffusion in the Knudsen region.

Molecular Diffusion Studies in Gases at High Temperature. I. The "Point Source" Technique. R. E. Walker and A. A. Westenberg. *J. Chem. Phys. 29,* 1139 (1958) Nov. (8 pp.)

Experimental apparatus and technique for a new method of measuring diffusion coefficients of gases are described and critically discussed. Method makes use of steady injection of a trace gas from a fine, hypodermic tube into a slow, uniform, laminar stream of a second (carrier) gas. Measurements of the trace gas concentration downstream of the source by means of precise gas sampling permit the binary diffusion coefficient to be determined. By heating the carrier gas, measurements may be extended to fairly high temperatures.

Molecular Diffusion Studies in Gases at High Temperature. II. Interpretation of Results on the He—N_2 and CO_2—N_2 Systems. R. E. Walker and A. A. Westenberg. *J. Chem. Phys. 29,* 1147 (1958) Nov. (6 pp.)

Experimental data on binary diffusion coefficients of He—N_2 and CO_2—N_2 obtained by the "point source" technique over the temperature range 300-1150°K are discussed in terms of intermolecular potential energies. For He—N_2, data can be satisfactorily represented by a purely repulsive potential. Data include extremes of the concentration dependence $D_{He\text{-}N2}$, i.e., with either He or N_2 present only as a trace component and this effect is taken into account in the theoretical interpretation. It is shown that, at their upper temperature limit, data come within 150° of overlapping the range of validity for the diffusion coefficient predicted from the repulsive potential obtained by Amdur *et al.* from molecular scattering experiments.

Ethane

Competitive Oxidations. Part 1. Ethane + Propane Mixtures. J. H. Knox, R. F. Smith and A. F. Trotman-Dickenson. *Trans. Faraday Soc. 54,* 1509 (1958) Oct. (6 pp.)

When mixtures of ethane and propane react with

oxygen, relative rate of disappearance of the two gases is 0.44 ± 0.03:1. This value is almost independent of temperature, composition and total pressure between 274° and 495°C. Chain propagation reactions in the oxidations of ethane and propane therefore have equal activation energies and radicals formed in the two propagation reactions attack a given hydrocarbon (ethane or propane) at equal rates. It is probable that the same radical is involved in both oxidations throughout the whole range of temperature and that this radical reacts with low activation energy with both hydrocarbons.

Fluid Flow

Electrolytic Methods for Measuring Water Velocities. W. E. Ranz. *J.A.I.Ch.E. 4,* 338 (1958) Sept. (5 pp.)

Convection-controlled mass transfer process in which rate of mass transfer results in an electrical signal should have certain advantages as working principle for a velocity- and turbulence-measuring device. Series of experiments showed that a working instrument could be designed on this principle, but that chemical actions involved were unreliable for consistent trouble-free results. Practical instruments appear to be possible only after long development and considerable study of chemical mechanisms.

Flow of Compressible Fluids. M. B. Powley. *Can. J. Chem. Eng. 36,* 241 (1958) Dec. (5 pp.)

Previously derived equations describing compressible flow have been rearranged in terms of known downstream conditions to facilitate determination of unknown upstream conditions. A 650 I.B.M. computor was used to solve the simultaneous equations numerically to permit construction of convenient design graphs in parametric form. Use of these graphs will eliminate a tedious trial and error computation formerly necessary with presently available methods when the upstream pressure and temperature are to be determined in gas flow problems. Application to design is illustrated by a worked sample.

Generalization of I. I. Novikov's Paradox in the Case of the Flow of Gas in Conditions of Convection Heat Exchange and Friction. S. V. Romanenko. *Appl. Mech. Rev. 11,* 640 (1958) Nov. (From *Izv. Kievsk. Politekhn. in-ta 18,* 326 (1955) (7 pp. Russian text.); *Ref. Zh. Mekh.* (1957) No. 2, Rev. 2018)

The fact is examined, as a paradox, that when there is adiabatic flow of gas along a cylindrical tube, the alteration of the condition parameters is determinable in a well-defined manner (within the framework of a one-dimensional model) by assigning an initial and end value for the number *M,* and does not depend to any extent on the length of the conduit and the viscosity of the gas. This result is generalized for the case of a flow of gas along the tube at constant temperature in the presence of convection heat exchange between the gas and the walls of the tube.

A. A. Gukhman

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On the Generalized Integral Operator Method in the Subsonic Diabatic Flow of a Compressible Fluid. M. Z. Krzywoblocki. *Appl. Mech. Rev. 11,* 626 (1958) Nov. (From 9th Con. Internat. Mech. Appl., Univ. Bruxelles, 1957; *2* 414 (6 pp.)

Bergman's method of linear integral operators is generalized and applied to solve system of linearized equations in the hodograph plane for the diabatic subsonic flow of a perfect, nonheat-conducting fluid, with sources or sinks of heat in the flow field. Author shows that the stream-function equation, the method of solution and the domain of uniform convergence are formally the same as those for the adiabatic subsonic flow (original Bergman method). Various applications to practical problems will be discussed in another paper (to be published).

G. Sestini

Theoretical Analogies between Heat, Mass and Momentum Transfer and Modifications for Fluids of High Prandtl or Schmidt Numbers. A. B. Metzner and W. L. Friend. *Can. J. Chem. Eng. 36,* 235 (1958) Dec. (6 pp.)

Current analogies for turbulent flow inside smooth round tubes are reviewed in detail; an empirical coefficient in the most promising equation is evaluated experimentally using the first heat transfer data of high accuracy obtained in the region of Prandtl numbers above 100. Final correlation is based on both heat and mass transfer data, and covers Prandtl (or Schmidt) numbers from 0.46-3000. Up to Prandtl or Schmidt numbers of 600 the results are correlated with a standard deviation of 9.4%.

Transport Processes between Fluids and Clouds of Suspended Particles: Some Exact Solutions. D. B. Spalding. *Appl. Mech. Rev. 11,* 642 (1958) Nov. (From *Proc. Roy. Soc. Lond. 242,* 430 (1957) Nov. (13 pp.))

Paper relates to processes such as the burning of pulverized solid fuel and of liquid fuel sprays, absorption of a gas component by a solvent spray, etc., and takes account of convection and turbulent mixing of the cloud. The Eulerian equation of conservation for the steady process is shown to be transformable into the Fourier equation for unsteady heat transfer in a flowing media. Exact solutions are given for a one-dimensional system, an axially symmetrical system

and the steady-flow homogeneous reactor. Numerical methods are indicated for more complex systems, and the possibility of solution by means of an analogue is pointed out.

From the author's summary by A. H. Shapiro

Turbulence Measurements in Supersonic Flow with the Hot-Wire Anemometer. B. Wise and D. L. Schultz. *Appl. Mech. Rev. 11,* 631 (1958) Nov. (From *Aero. Res. Counc. Lond. curr. Pap. 366,* 13 pp. + 19 figs. 1957.)

Hot-wire anemometer equipment developed by the author is described and sample measurements in a supersonic wind tunnel at M=1.6 are briefly discussed. For low noise level, transformer coupling was used between wire and amplifier. Time constant calibration was executed by injection of modulated R.F. power (5.5 Mc carrier). The free-gas stream turbulence in the tunnel was analyzed and the fluctuations were decomposed into stagnation temperature and mass flow fluctuations.

L. S. G. Kovasznay

Fractionation

Kittel Plates. B. Pollard. *Chem. and Ind.* 1414 (1958) Nov. 1 (5 pp.)

Kittel contacting system, although based on perforated plates, has unique factors which distinguish it from others and which give it flexibility in operation. Each type is designed to accomplish best particular duties. Basic principles of operation are in each case similar, the variations being made to cater for wide differences in gas/liquid rates, operating pressure, liquid viscosities, and diffusion rates between the phases. Standard Kittel plate employs different grid designs. As each pair corresponds to what is usually one plate, the two grids together are for convenience termed "a Kittel plate."

Heat Transfer in a Laminar Boundary Layer with Constant Fluid Properties and Constant Wall Temperature. A. G. Smith and D. B. Spalding. *Appl. Mech. Rev. 11,* 639 (1958) Nov. (From *J. Roy. Aero. Soc. 62,* 60 (1958) Jan. (5 pp.)

Approximate procedures are generally used to calculate heat transfer in a laminar boundary layer around objects of arbitrary shape because an exact solution of the velocity and temperature boundary layers is very tedious. The present paper simplifies a procedure previously presented by E. Eckert in which the problem is reduced to the solution of a first-order ordinary differential equation. The simplification is based on the fact that for wedge-type flow the connection of a parameter appearing in the differential equation and of the boundary-layer thickness parameter can be well approximated by a linear expression. This permits a solution of the differential equation by a simple quadrature. A calculated example shows good agreement with calculations by Eckert and Schuh.

E. R. G. Eckert

Heat Transfer to a Liquid Fluidized Bed. R. Lemlich and I. Caldas, Jr. *J.A.I.Ch.E. 4,* 376 (1958) Sept. (5 pp.)

Experimental study of the rate of heat transfer from the retaining wall to a fluidized bed of solids was carried out for liquid water and glass spheres. Independent variables included mass velocity, particle size, bulk temperature and wall temperature. Significant increases in heat transfer were observed, because of the presence of suspended solids, even to the extent of tripling the coefficient. For each of several particle sizes, the coefficient passed through a maximum corresponding to a particular mass velocity. Behavior of the bed at velocities below and above those for maximum coefficient was studied and categorized. Tentative correlations for both regions are offered.

Heat Transfer from Surfaces of Nonuniform Temperature. D. B. Spalding. *Appl. Mech. Rev. 11,* 639 (1958) Nov. (From *J. Fluid Mech. 4,* 22 (1958) May (10 pp.))

Improvement is presented of Lighthill's method of calculating steady heat transfer from a surface of arbitrary temperature distribution to a laminar stream of arbitrary velocity distribution. Lighthill's method, which allows the ratio between thermal and momentum boundary-layer thickness to vary, considers the case where the thermal boundary layer is much thinner than the momentum boundary layer, and, therefore, lying within a region of linear velocity profile. Paper describes a correction to Lighthill's method which accounts for the nonlinearity of the velocity profile within the thermal boundary layer. It is claimed that this error in Lighthill's method is reduced to a maximum of 2.5% even for cases of a thick thermal boundary layer. In addition, an attempt is made to show that the Tribus-Klein correction to Lighthill's method may have adverse effects. The improvement may be summarized as consisting of a) a better allowance for velocity profile nonlinearity; b) the use of an enthalpy thickness for calculating the heat transfer over a finite surface area, and c) a quadrature procedure for integrating the continuation equation for the boundary layer thickness.

R. J. Mindak

A Method of Studying the Influence of Flame Characteristics on Heat Transfer in Furnaces. A. M. Godridge, G. G. Thurlow and J. Wallis. *J. Inst. Fuel 31,* 491 (1958) Nov. (15 pp.)

Apparatus is described in which a small flame is burned inside a vertical, cylindrical, insulated combustion chamber, 5 in. in diameter, and results are given of measurements of the heat flow through the furnace walls, temperature, gas analysis and radiation characteristics of the flame.

Theory of Thermal Lag of Hot-Wire Anemometers in a Flow of Gas with Pulsating Velocity. N. A. Yaryshev. *Appl. Mech. Rev. 11,* 631 (1958) Nov. (From *Sb. rabot stud. nauch. o-va Leningr. in-ta tochhnoimekhan-i optiki,* 71 (1955) No. 13 (8 pp. Russian text); *Ref. Zh. Mekh.* (1957) No. 2, Rev. 2118.)

From the equation of thermal equilibrium an equation is deduced for the elevation of the temperature of the wire of the hot wire anemometer above the temperature of the oncoming medium in relation to time with the given mass and dimensions of the wire, current flowing along the wire, coefficient of heat emission. The equation is solved with the retention of terms of the first order smallness. An expression is obtained for "the constant time" of the hot wire anemometer, which (in other denotations) agrees precisely with that obtained earlier by Yu. G. Zakharov.

A. S. Danilov
Courtesy Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

Turbulent Heat Transfer in the Thermal Entrance Region of a Pipe with Uniform Heat Flux. E. M. Sparrow, T. M. Hallman and R. Siegel. *Appl. Mech. Rev. 11,* 639 (1958) Nov. (From *Appl. Sci. Res. 7,* 37 (1958) 1 (16 pp.))

Report derives local and fully developed Nusselt numbers for several values. Numerical solutions for fully developed flow and entrance flow are given. Comparison with other analytical investigations is given as is comparison with experimental results for water and air. In general, agreement with experiment is fairly good. Analytical results also compare well with empirical correlation given by McAdams. Major result is marked decrease in entrance length as Prandtl number increases and insensitivity of entrance length to Reynolds number. Results complement those of Graetz for laminar thermal entry region, and will be of interest in many fields such as nuclear reactor design.

B. W. Augenstein

Hydrocarbons

Critical Temperatures and Pressures of Hydrocarbons. J. C. Forman and G. Thodos. *J.A.I.Ch. E 4,* 356 (1958) Sept. (6 pp.)

Method developed for calculation of van der Waals. constants, both *a* and *b* for hydrocarbons usually encountered, enables direct calculation from a consideration only of the molecular structure of the hydrocarbon. This approach has become possible through the assignment of group contributions to different types of carbon atoms which can be combined in any manner to produce the van der Waals' constants representative of the molecular structure of the hydrocarbon.

Free Hydrocarbon Radicals. Their Reactions in the Gas Phase—Part 1. A. F. Trotman-Dickenson. *Petrol. 21,* 371 (1958) Oct. (4 pp.); **Their Reactions in the Gas Phase—Part 2.** *Ibid.,* 406 (1958) Nov. (5 pp.)

Free radical reactions in gas phase have progressed from an isolated item of interest to a major tool of research workers and possibly will become a recognized large-scale manufacturing method in the near future. Part 1 deals with current knowledge of radical decompositions and combinations and radical transfer reactions. Discussion in Part 2 is concerned with disproportionation reactions, decompositions of radicals and additions of radicals to double bonds, isomerizations of radicals and reactions of biradicals.

Reactions of Gaseous Ions. V. Methane-Hydrogen Chloride and Methane-Hydrogen Sulfide. F. H. Field and F. W. Lampe. *J. Am. Chem. Soc. 80,* 5583 (1958) Nov. 5 (4 pp.)

Specific reaction rates and cross sections of the gaseous ion reactions occurring in mixtures of methane with hydrogen chloride and methane with hydrogen sulfide have been measured at a field strength of 10 volts/cm. Extrapolation of these values to zero field strength has been made in the methane-hydrogen chloride system. Reactions that do proceed in these systems allow the calculation of lower limits of 120 and 175 kcal/mole for the proton affinities of hydrogen chloride and hydrogen sulfide, respectively.

Reactions of Gaseous Ions. VI. Hydride Ion Transfer Reactions. F. H. Field and F. W. Lampe. *J. Am. Chem. Soc. 80,* 5587 (1958) Nov. 5 (6 pp.)

Secondary ions of mass one unit less than those of the parent ions have been observed in C_2H_6, C_3H_8, n-C_4H_{10}, neo C_5H_{12}, neo-C_6H_{14} and mixtures of these compounds with CH_4. By means of appearance potential measurements it has been established that the reaction occurring in neopentane is a hydride ion transfer to the allyl ion, and it is inferred that the secondary ions observed from the other compounds also are formed by means of hydride ion transfer reactions. Approximate calculations of the reaction cross sections are made, and the values obtained range from 264 A for ethane to 7 A for neohexane.

Mass Transfer

Estimate Efficiency in Mass Transfer. J. O. Osburn. *Chem. Eng. 65,* 119 (1958) Dec. 1 (4 pp.)

Review methods of calculating over-all, plate and point efficiencies in bubble-cap or sieve plate columns during distillation and absorption.

Mass Transfer in a Bubble Column. A. I. Johnson and C. W. Bowman. *Can. J. Chem. Eng. 36,* 253 (1958) Dec. (9 pp.)

Effects of gas and liquid flow rates and of seal height on the absorption of carbon dioxide in water have been studied. Gas bubbles were formed from 1/16 in. orifices, with both single and multiple hole arrangements. Bubble frequencies were measured using a high speed motion picture camera and are reported graphically. At high flow rates considerable breaking up of the bubbles was observed.

Mathematical Methods

How Wrong Can Your Calculations Be? R. H. Cortes. *Petrol. Refiner 37,* 129 (1958) Oct. (2 pp.)

Right equations may be properly applied, but data can contain errors. Method known as propagation of error can be used to estimate errors. Equation for method is subject to restriction that errors of measured quantities must be independent of each other. This means method selected for measurement of any quantity must not influence result obtained when measuring any of the other quantities.

Mercaptans

The Dipole Moments of Alkanethiols. S. Mathias and E. de Carvalho Filho. *J. Phys. Chem. 62,* 1427 (1958) Nov. (4 pp.)

A number of aklanethiols were carefully purified and the boiling points, refractive indices and dielectric constants were determined. Dipole moments of these compounds in benzene solution and in the pure liquid state at 25° were calculated. In the last case, the equations of Debye, Onsager and Yasumi and Komooka were employed and results compared with corresponding values in solution. Best agreement was presented by Onsager's equation.

Methane

Freezing Points of Binary Mixtures of Methane. J. Brewer and F. Kurata. *J.A.I.Ch.E. 4,* 317 (1958) Sept. (2 pp.)

Experimental freezing point data of the methane-*n*-hexane and the methane-*n*-octane binaries are presented and compared with the methane-carbon dioxide system previously investigated. Step-by-step variation of freezing point in the paraffin homologous series is exploited to provide reasonably accurate extrapolation of experimental data on the two binaries and scattered freezing point data on the methane-*n*-butane mixture to other paraffin hydrocarbon mixtures of methane in which the heavier constituent ranges from ethane to *n*-nonane, inclusive. Composite graph of freezing points of various binaries with methane, from ethane to *n*-nonane, is presented.

Mechanism of Reaction of Recoil Hydrogen in the Gas Phase. M. A. El-Sayed, P. J. Estrup and R. Wolfgang. *J. Phys. Chem. 62,* 1356 (1958) Nov. (8 pp.)

Interaction of high energy tritium (H^3) formed by nuclear recoil with gaseous methane and ethane has been investigated under a wide variety of conditions. In the case of methane, a number of labeled products, chiefly HT and CH_3T, together with smaller amounts of higher tritium labeled hydrocarbons are formed. If a radical scavenger such as I_2 is present the yield of CH_3T is little changed but the amount of HT is halved and the higher hydrocarbons eliminated. These results are not consistent with present theories of the mechanism of the primary step of hot-atom reaction. An alternative hypothesis that reactions of gas phase hot "atoms" are really due to ions does not appear tenable in the case of recoil tritium. A mechanism involving a high energy one-step displacement reaction as the primary reaction of the hot atom is suggested. Some of the labeled products of this primary reaction reach thermal energies as radicals which will then undergo further secondary reaction.

Ore Reduction

Blast Furnace Burden Frozen to Study Nature of Iron-Making Process. *Ind. Heating 25,* 2286 (1958) Nov. (2 pp.)

Recent experiment may reveal some of the mysteries of iron-making. Contents of an experimental blast furnace were "frozen" during iron-making process to enable a study of changes that occur during transformation of raw materials to iron. Experiment was conducted in October, 1957, when U. S. Bureau of Mines moved its 34-ft tall experimental blast furnace from Pittsburgh to Bruceton, Pa. U. S. Steel Corp. specialists developed idea in cooperation with U. S. Bureau of Mines and nitrogen for experiment, a costly factor, was supplied by Linde Co.

Phase Equilibria

II. The Ammonia—Isooctane System. W. B. Kay and F. M. Warzel. *A.I. Ch.E. J. 4,* 296 (1958) Sept. (4 pp.)

Because of the paucity of data on the phase behavior of binary systems that form azeotropes, the P-V-T-x relations of the ammonia-isooctane system were de-

termined at the liquid-vapor boundaries from room temperature to the critical temperature of isooctane. Evidence of an azeotrope existing over a very limited pressure and temperature range was obtained. The system is unique in that the critical locus contains a minimum temperature point as well as a minimum and a maximum pressure point. These relations are shown to fit a general pattern of phase relations characteristics of binary systems that form azeotropes in the critical region. This pattern serves as an aid for the qualitative prediction of the P-T-x relations of such systems.

Propane

The Solubility of Propane in Water. A. Azarnoosh and J. J. McKetta. *Petrol. Refiner 37,* 275 (1958) Nov. (4 pp.)

Experimental and smoothed data are given for pressures from atmospheric to 500 psia and for temperatures from 60-280°F. Static method is used whereby water and propane are placed into an equilibrium cell, the cell is rocked for several hours, then the water-rich liquid is sampled directly into the analytical train.

Solubility

Regular Solution Theory for Gas-Liquid Solutions. J. M. Prausnitz. *A.I.Ch.E.J. 4,* 269 (1958) Sept. (4 pp.)

Regular-solution equations developed by Hildebrand and others are useful for obtaining semiquantitative estimates of phase equilibria in nonpolar systems. These equations, however, do not take into account the volume change on mixing and therefore require modification for solutions of gases in liquids. The required modifications are presented in this paper, and the resulting equations give reasonable estimates of the solubilities of gases and of the temperature coefficient of solubility. In the modified form the regular-solution theory may be used to estimate gas-liquid phase equilibria at high pressures.

Sulfur Dioxide

Electron Impact Studies of Sulfur Dioxide and Sulfuryl Fluoride. R. M. Reese, V. H. Dibeler and J. L. Franklin. *J. Chem. Phys. 29,* 880 (1958) Oct. (4 pp.)

Mass spectra and appearance potentials have been obtained for principle positive and negative ions of SO_2 and SO_2F_2. Ionic heats of formation and probable ionization-dissociation processes are tabulated. Electron-impact data for SO_2 support values of 3.3 ev for $D(S_2)$ and 5.15 ev for $D(SO)$. Molecular ionization potential is in good agreement with recent photoionization measurements.

Viscosity

To Get Viscosity for a Gas Mixture. W. R. Gambill. *Chem. Eng. 65,* 157 (1958) Nov. 17 (4 pp.)

Discussion of various estimation methods with which mixture viscosities may be calculated from known pure-component viscosities. Separate treatments of estimation methods for low-pressure and high-pressure conditions are given.

Viscosity Equations for Gas Mixtures. W. E. Francis. *Trans. Faraday Soc. 54,* 1492 (1958) Oct. (6 pp.)

Simplified relation between viscosity of a gas mixture and viscosities of individual components is derived from the rigorous kinetic theory equations. New relation appears to fit known experimental data with an accuracy of about $\pm$ 2%, and can be applied to mixtures containing a polar component. Equation has been tested on a large number of mixtures of gases of widely differing molecular weights and viscosities, involving considerable departures from the simple mixing rule. Limitations of various equations which have been proposed in the past are discussed, and it is shown that the new equation probably represents the best approximation possible with one of the Sutherland-Thiesen type.

Viscosity: Reduced-State Correlation for the Inert Gases. H. Shimotake and G. Thodos. *A.I.Ch.E.J. 4,* 257 (1958) Sept. (6 pp.)

A reduced-state viscosity correlation has been constructed from the available data of the inert gases. The fragmentary experimental data for argon were utilized along the lines proposed for thermal conductivities by Owens and Thodos (21) in order to determine the effect of pressure on viscosity. The only available low-pressure viscosity data for neon and helium have been incorporated for the effect of subatmospheric pressures. This correlation covers the range of pressures include between $P_R = 40$ and $P_R = 0.015 \times 10^{-4}$ and extends up to temperatures of $T_R = 100$. The effect of subatmospheric pressures on viscosity does not become significant above pressures of 1 mm. of mercury. However, at lower pressures, viscosity is found to decrease rapidly, particularly in the regions below absolute pressures of 0.01 mm. of mercury. Viscosities calculated with the reduced state correlation produce an average over-all deviation of 0.93% for neon, argon, krypton, and xenon. The available data for the gaseous and liquid states have been included. Deviations of the same order of magnitude are produced for helium in the gaseous state; however, these deviations become excessive for in the liquid state. The application of the final reduced state correlation has been extended to a number of diatomic and polyatomic gases and found to apply well to the diatomic gases only.

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American Gas Journal
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American Petroleum Institute Quarterly
American Society for Testing Materials Bulletin
American Society of Mechanical Engineers, Transactions of
Analytical Chemistry
Appliance Manufacturer
Applied Chemistry, Journal of
Applied Mechanics, Journal of
Applied Mechanics Review
Applied Physics
Applied Spectroscopy
Australian Journal of Applied Science
Australian Journal of Chemistry

Battelle Technical Review
Bituminous Coal Research
Brennstoff-Chemie (German)
British Coal Utilization Research Association Monthly Bulletin and Quarterly Gazette
Business Week
Butane-Propane News

California Oil World
Canadian Chemical Processing
Canadian Gas Journal
Canadian Journal of Chemical Engineering
Canadian Journal of Physics
Ceramics (British)
Chemical and Engineering News
Chemical & Process Engineering
Chemical Education, Journal of
Chemical Engineering
Chemical Engineering Progress
Chemical Engineering Science
Chemical Processing
Chemical Physics, Journal of
Chemical Reviews
Chemical Society, Journal of (British)
Chemical Week
Chemistry & Industry (British)
Coal-Heat
Coal Utilization
Coke and Gas (British)
College Placement, Journal of
Combustion
Combustion and Flame (British)
Computers and Automation
Construction Methods and Equipment
Control Engineering
Corrosion
Corrosion Technology (British)
Cost Engineering

Drilling

Electronics
Engineers' Digest (British)
Erdöl und Kohle

Faraday Society, Transactions of (British)
Fuel (British)
Fuel Efficiency (British)
Fueloil & Oil Heat

Gas
Gas Age
Gas & Oil Power (British)
Gas Council Research Communications (British)
Gas Heat and Comfort Cooling
Gas Journal (British)
Gas Times (British)
Gas- und Wasserfach (German)
Gas World (British)
Gasovaya Promyshlennost (Russian)

Heating, Piping & Air Conditioning

Independent Petroleum Association of America Monthly
Industrial and Engineering Chemistry
Industrial Finishing (British)
Industrial Gas (American)
Industrial Gas (*British*)
Industrial Heating
Industrial Laboratories
Industrial Science and Engineering
Institute of Fuel, Journal of (British)
Institute of Gas Technology Research Bulletins
Institute of Petroleum, Journal of (British)
Institution of Gas Engineers Bulletins and Communications (British)
Instrumentation
Instruments and Automation
Izvestiya Akademii Nauk S. S. S. R. Otdelenie Khimicheskikh Nauk (Russian)

Jet Propulsion

Khimiya i Tekhnologiya. Topliva i Masel (Russian)

Laboratory Practice (British)
LP-Gas
Lubrication
Lubrication Engineer

Materials in Design Engineering
Mathematical Tables and Other Aids to Computation
Mechanical Engineering
Metal Progress
Metals, Journal of
Mining Engineering

National Advisory Committee for Aeronautics Reports, Technical Memoranda and Notes
National Fire Protection Association Quarterly
National Gas Bulletin of Australia
National Petroleum News
Nuclear Science and Engineering
Nucleonics

Oil and Gas Journal
Optical Society of America, Journal of

Petroleum (British)
Petroleum Engineering
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Petroleum Technology Journal of
Petroleum Week
Physical Chemistry, Journal of
Physics and Chemistry of Solids (British)
Pipe Line Industry
Pipeline News
Power
Producers Monthly
Product Engineering
Progress (Pakistan)
Public Utilities Fortnightly

Refrigerating Engineering
Research, Journal of
Research & Engineering
Review of Scientific Instruments
Revue Generale du Gaz (Belgian)
Rivista dei Combustibili (Italian)

Science
Scientific Instruments, Journal of (British)
Svenska Gasverksföreningens Månadsblad (Swedish)

U.S. Bureau of Mines Bulletins, Information Circulars and Reports of Investigations
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Usines a Gaz, Journal des (French)
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